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VOL. XIV. NEW YORK, DEC. 28, 1889. No. 26.

The Harvest of the Year.

As this is the last issue of Volume XIV. and of the year, it is befitting to look back over the record of the paper. The exhibit of progress made is a very striking one. During 1889, THE ELECTRICAL WORLD has contained **816** reading pages or **126** more than in 1888. It has printed no fewer than **537** illustrated articles and in the neighborhood of **1,500** cuts. It embraced, moreover, a number of special articles and series of great interest, and distinguished itself also not only by the space devoted to the electrical displays at the Paris Exposition, but by sending a special representative to attend and report by cable the International Electrical Conference. In this and other ways, the paper evinced the enterprise of its management, and gave pledges as to the continuance of the policy that has rendered the journal invaluable to every electrician. A complete idea of the contents for 1889 may be found upon reference to the six-page Index which accompanies this issue.

Designing Transformers.

WE print in this issue the second part of Mr. J. Swinburne's excellent article on the designing of commercial transformers. In this Mr. Swinburne takes up the subject of the induction which occurs in the iron of the core and the work lost in it; and he shows that a clear distinction must be made between the losses due to Foucault currents and those due to hysteresis. He also describes the various types of transformers which have been brought out, and discusses the relative advantages of each. Mr. Swinburne remarks very aptly that the transformer is like most pieces of electrical apparatus, a sort of compromise between a variety of conditions, some of which, though actually of greater importance in one sense, have to give way to other considerations dictated as the results of expedience and experience.

Solar and Arc Heat.

DURING the past ten years a number of investigators have bent their energies to the determination of the properties of the arc light, its comparison with that of sun, and its efficiency as a method of illumination. One of the best of these researches is that in the paper on "The Efficiency of Modern Methods of Illumination," read by Prof. E. L. Nichols before the American Institute of Electrical Engineers in March last, which contained an exhaustive study of the light-giving value of the arc and incandescent lamp, and which entered notably into the determination of the relative light-giving value of the arc at different parts of the spectrum. It is satisfactory to note that Prof. Langley has arrived at almost exactly the same results. He has, however, studied more particularly the relative distribution of heat in different parts of the spectra of the arc and the sun. These results show as great differences, if not greater, between the two sources of energy as is the case in their light-giving properties.

Overhead Railway Construction.

ALTHOUGH the general principles on which the modern electric railway is operated are thoroughly well understood by many, there are not a few who are still unacquainted with some of the details, and for such the description by Mr. E. P. Roberts of the various methods employed in running the overhead conductors will be welcome. Mr. Roberts shows the various plans which have been put in operation, or proposed, both for the parallel system of working with ground return and the series system. He discusses in a very clear manner the disturbances which can, under certain circumstances, be caused by crossing or grounding of the wires; but it will be noted that in practically all cases no permanent stoppage due to lack of current results from a disarrangement in the circuits. This is certainly a strong factor in support of the reliability of the railway, and that alone, if nothing else, would show its superiority over the cable railway, which is dependent upon a single thread, so to speak, for the continuity of its operation.

Tests of Transformers.

THE American Institute of Electrical Engineers has already received more than one valuable contribution from the physical laboratory of Cornell University, and that which Prof. Harris J. Ryan contributed to the Institute at its last meeting, was well calculated to attract the members, who appeared in force. Professor Ryan and Mr. Merritt, without attempting to improve upon what has thus far been accomplished, took a commercial transformer as it is supplied by the manufacturer, and subjected it to a variety of tests in order to obtain its actual commercial value. The results of these tests are well shown in the series of curves which have been plotted, and which accompany the paper. They illustrate in an excellent manner the effect of retardation or lag in the transformer, and the modifications which take place from the curves which theory would assign. The effect of hysteresis is very clearly brought out. It will also be noted that, as has been referred to on more than one occasion, the transformer showed a comparatively low efficiency at a light load, while at half load 77.5, and at full load 86.6 per cent. efficiency was obtained. The discussion which followed the reading of Professor Ryan's paper brought out a number of interesting points, and was participated in by Messrs. Tesla, Kennelly, Geyer, Stillwell, Acheson, Mailloux and others, to which we shall have occasion to refer at a future time.

Funny Reasoning on Ventilation.

Mr. A. B. SLATER, in a paper read before the Society of Gas Lighting, makes the following curious argument: "The better class of regenerative burners, where the ceilings are high enough to admit of their use, will furnish a light more satisfactory in all respects than any electric light of equal cost. It is sometimes said they are objectionable on account of the heat. Except in the case of low ceilings, this is more imaginary than real. The heat is a positive benefit where there is proper ventilation, as there should be, because it causes a change of air, which is certainly preferable to no ventilation with the electric light, and the air is vitiated by being breathed over and over again, which is likely to be the case where no attention is given to ventilation, for the reason that the electric light is said not to vitiate the air.' The state of mind revealed by such reasoning is deplorable, simply deplorable. As will be observed, regenerative burners can only be used where the ceilings are high enough to allow it. We have yet to meet the man who would care to sit near one, yet "the heat is a positive benefit where there is proper ventilation." Then Mr. Slater assumes that the results of using gas are so bad that people must have ventilation, while the results of using electricity are so good that people will forget about ventilation. In other words, because a man likes good light he will not want pure air. Mr. Slater is evidently one of those who believe that a gas jet should be at once a bad lamp and a poor stove.

Wires in New York City.

THE wire-cutting campaign has been continued actively throughout the week all over the city, in the subway districts, and low-tension as well as high-tension circuits have gone down before the lineman's axe. As we have pointed out before, the public and the authorities do not stop to consider the difference of a few hundred volts, and have no clear comprehension of the subject, but find a sweet simplicity in the policy of cutting down every wire, good, bad and indifferent. The result is that there has been a general stay of outdoor electrical business, and the company that has put up the best wires obtainable has fared no better than the company that neglected every precaution that reason and experience would dictate. In other words, the city officials have spent thousands of dollars in wrecking property worth hundreds of thousands, and have nothing but dark streets to show for the trouble. There is already sign of the reaction, as an instance of which we may quote the following from the New York *Times*, which has been publishing columns of wire-cutting news with such captions as "A Very Good Day's Work" and other absurd phrases of the kind: "While this crusade against dangerous wires is going on so vigorously, and the twinkling gas lamps are reviving so slowly, may it not be pertinent to inquire whether there are any safe electric light wires, whether anything is doing to replace the dangerous ones with those that are safe, or otherwise to provide for a resumption of the lighting of the streets by electricity? The work of destruction is evident enough, but is anything going on in the way of construction, or are we to sit in darkness and admit that street lighting by electricity is a failure? The removal of dangerous wires ought not to be equivalent to the complete extinction of the electric lamps. The companies seem to be doing nothing, and the public authorities are giving their whole attention to tearing down, as if doomsday were near and we were never more to have occasion for lighted streets. There will be a reaction of public sentiment if some attention is not given to the question of restoring the light under safe conditions."

The Vagaries of the Press.

IN a recent letter from the interior wilds of Africa, the brave explorer Stanley writes with regard to some newspaper articles he has received, that they are stamped with "an utter lack of common sense and a total disregard of accuracy." We are sorry that such a description should apply to the recent articles in the New York papers on the electrical situation; but there is the fact, and we can only hope that the great dailies will soon resume their coolness and reasonableness, and their functions as intelligent leaders of opinion. The nonsensical and extravagant statements about electricity in the papers are so numerous that it is useless to try to keep up with them. A few examples will suffice. The *Sun*, for instance, has a lunatical article on what might happen if the elevated railroad structure became charged "even by a non-fatal electric current." Then the *Evening Post*, which one always supposed to be conducted by educated men, has an editorial in which it says "one scarcely ventures to put a latch key into his own door." The *Mail & Express* tries hard to match this with an alarmist item from Washington, stating that Secretary Proctor's desk had been set on fire by its electric bell wire! The *Herald*, not to be outdone in folly, says: "So long as gas holds out, we won't encourage a modern improvement which may at any moment set fire to our buildings and kill our citizens. Look at it in that way, Mr. Gilroy, and bless you, dear boy." Any one would, of course, suppose from this that gas, although like steam, one of the greatest "modern improvements," had not killed thousands of people and destroyed millions and millions of property. If the *Herald* wishes, we will match its undignified paragraph with a dozen from old papers enlarging on the dangers of gas and railroads in their early days. But "modern improvements" survive their critics of this calibre, and our daily newspaper friends may as well take it for granted now as later that no matter how sillily they write about electricity, it will outlive their wild assertions and attacks, and that though they forget their mission as advocates of development and invention, the advance will go on. If electricians can have the help and cheer of the daily papers, so much the better; but they can get along without it, and are certainly indignant and contemptuous when the assault on themselves and their work takes the form indicated in this handful of quotations.

ELECTRICAL WORLD PORTRAITS—X.

STEPHEN D. FIELD.

The subject of the present sketch would not have been worthy his name had he not done something to distinguish himself. The Field family is one which by sheer force of merit has become so prominent in this country that it may be questioned whether any other can be given an equal position for intellectual ability and public service. To-day it is represented on the bench of the Supreme Court of the United States by one member, while another member stands pre-eminent as a lawyer and publicist. A third member has long been an honored leader in divinity and literature, as well as in journalism. Through Cyrus Field, the name has been gloriously and indissolubly connected with the submarine telegraph; while in Stephen D. Field it has found a representative of versatile genius, and of most varied achievement in the later applications of the electric art.

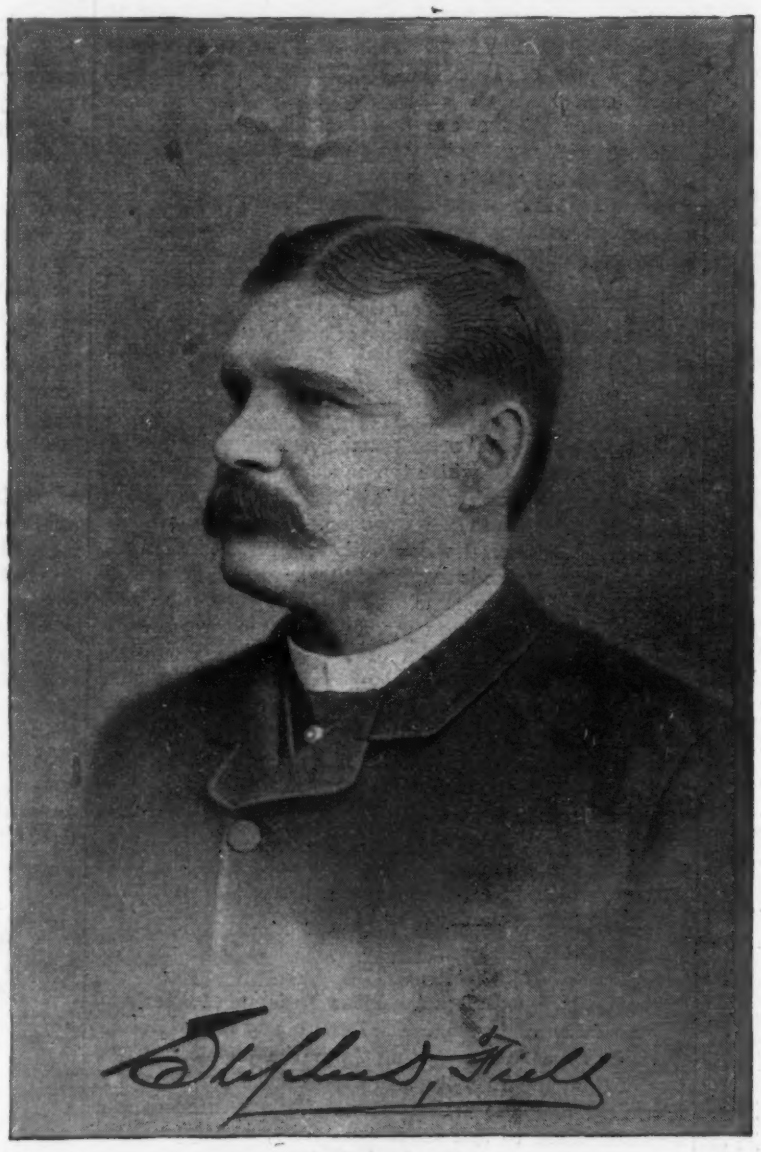
Mr. Field was born at Stockbridge, Mass., Jan. 31, 1846, and there received his early education and training. When the first Atlantic cable was laid, the event was naturally regarded up among the quiet Berkshire Hills as one of more than usual importance, and the town, proud of its direct connection with the heroes of the occasion, celebrated the success of the wonderful new enterprise. For the purpose of sending a report of the proceedings, the American Telegraph Company opened an office in the town, and the instruments were located in the law office of young Field's father. Being of strong mechanical tastes, the boy was greatly attracted by the apparatus. In a short time he had mastered the system and had become quite expert as an operator. In fact, he occcupied his school vacations subbing for telegraphers in various parts of the district, and thus accumulated no small amount of spending money for the school terms. It is needless to tell Mr. Field's friends that the money was spent. The little line upon which the Stockbridge office was located ran from Great Barrington to Pittsfield, Mass., and it was upon this line that the Pope brothers and T. D. Lockwood also learned or practiced their profession.

Mr. Field's first invention was made about this time,and was an apparatus designed to answer when the office call passed on the wire, receive and record the message, and answer "O. K." at its termination. Lord Beaconsfield speaks somewhere of the delight a young man takes in his first epigram. Mr. Field had no particular delight or enthusiasm over this first invention. It was simply intended to subserve his enthusiastic delight in baseball. The Stockbridge line, though short, was poorly insulated, and a little misunderstanding with the Popes, caused by a failure to adjust the office relay properly, led to a second invention designed to keep the line current at the same strength at all times. It consisted of a series of resistances, a switch, an electric motor and a galvanometer. The galvanometer governed the motor, the motor worked the switch, and the switch brought in more or less resistance to the circuit. The apparatus was designed under the erroneous idea that the battery variation caused the frequent changes required in the relay adjustment.

In 1863 Mr. Field removed to California, and for a few months was in the service of the California State Telegraph Company. About a year later he was appointed an operator in the San Francisco Fire Alarm Telegraph, in which capacity he remained for five years, exchanging positions with the lineman for one year in order to learn thoroughly that humble but vital part of the business. This work was not enough, however, to engage all the energies of such an active man, and during these years, therefore, he carried on a separate business in general electrical construction. In 1871 he resigned to accept the position of electrician of the Pacific Division of the Western Union Telegraph Company, and secretary and electrician of the Electrical Construction and Maintenance Company. In the latter position he remained until his permanent return to the East in 1879. One incident of this period was his association with Mr. F. L. Pope in the construction of the Russo-American Telegraph line, upon which well-planned but unfortunate enterprise Mr. George Kennan, the *Century's* champion of the Siberian exiles, was also employed.

It was about this time also—1865 to 1879—that Mr. Field, who had by this time become a persistent inventor, busied himself with ideas as to the construction and operation of electric railways, as the result of which he secured the patents granted him on the invention. A long account of his work will be found in Martin and Wetzler's "Electric Motor and its Applications," and the recent discussion of his claims, owing to the issuance of a patent covering broadly the main features of overhead wire and conduit system operation, will be fresh in the minds of our readers. Mr. Field was thrown into interference in the Patent Office with Siemens and Edison, and Siemens is now fighting the issue in the United States courts. There can be no question as to Mr. Field's active early interest in electric railway work, and it will be interesting to see in what degree his claims are sustained.

During his career, Mr. Field has practically operated nearly every known application of electricity and has been the pioneer in not a few, but it is perhaps in telegraphy that his inventions are best known. The introduction of his system of supplying current to telegraph lines by dynamos instead of by chemical batteries is recognized as one of the most distinct advances ever made by the Western Union Company. This and his quadruplex were, we believe, first applied on the company's lines in 1879. His multiple call district telegraph box with return signal was brought out in 1876. He has also devised several systems of sextuplex telegraph and has a new system of multiplex capable of indefinite extension. Another invention is a new system of magneto-telephone, which, with many of Mr. Field's more recent ideas, has been recently illustrated in the columns of THE ELECTRICAL WORLD. One of Mr. Field's leading inventions is his fast ticker system now in use by the Commercial Telegram Company, who have secured some remarkably satisfactory results with it in the way of quick and accurate transmission of quotations. It may be mentioned that Mr. Field at one time equipped with his duplex apparatus the lines of the Mutual Union Telegraph Company, and worked them entirely without condensers, thus avoiding the Stearns condenser patent, which was so formidable a Western Union weapon of patent litigation.



STEPHEN D. FIELD.

Personally, Mr. Field is a man far out of the common, of burly build, with an expressive, mobile, large-featured face, and with a remarkable command of terse, piquant language—so long as he is not required to address an audience. He is a most agreeable companion, and his generous, free-handed nature has won him a host of friends throughout the electrical profession. Of late years, his health has been somewhat broken, and he has lived quietly with his family in the retirement of the beautiful Berkshire Hills, the time-honored home of the Fields. He is a member of the American Institute of Electrical Engineers and the New York Electric Club, and has been an officer in both bodies. His genius is as fertile as ever.

Low-Pressure Continuous Currents Sometimes More Dangerous than Alternating Currents.

BY CHAS. STEINMETZ.

During the last few months much has been said about the dangers of electric currents, about ampère-shocks and volt shocks. Now, it appears to me that neither the volts nor the ampères of a circuit are the most important essentials of danger. There is another fact, known long ago, though often overlooked, which produces the most dangerous effects.

Suppose we have a battery of a few storage cells. We make and break contact, taking the uninsulated pole wires with both hands. The voltage being too low, we will feel nothing at all. Now, we put into the circuit an electro-magnet of large size, for instance, the field of a dynamo. The current is reduced, the voltage not increased. Nevertheless, in breaking the circuit now, we will receive a rather perceptible shock. What is the difference between this experiment and the first one? In the second case the *self-induction* of the circuit is increased, and it is the high electromotive force of self-induction which gives the shock, not the low battery potential.

This *electromotive force of self-induction* is quite *independent* of the *voltage*, and only depends upon the *current intensity* and the *coefficient of self-induction* of the circuit. A large coefficient of self-induction, even in a low-pressure circuit, will sometimes be more dangerous than the highest voltage ever used. From this point of view let us now consider the different systems of electric current distribution.

The alternating current has the very remarkable feature that the self-induction is nearly always equal to zero, because a small amount of self-induction would suffice to entirely stop an alternating current. Therefore in breaking a circuit of, for instance, 50 volts (the main currents of higher voltage should be properly insulated, and must be absolutely put out of reach) we are exposed only to the pressure of 50 volts, and that would not do any harm to a fly!

Now break a continuous current of 50 ampères; the coefficient of self-induction being 5, the time of breaking 0.01 second; then the mean electromotive force of self-induction would be:

$$E = \frac{50 \times 5}{0.01} = 25{,}000 \text{ volts.}$$

In reality, in the first moment the voltage would be still higher.

All the energy stored up in the magnetism of the electromagnets, in the fields of the electromotors, and in the lines of force would be discharged instantaneously through the body, and cause immediate death.

I concede that a self-induction of 5 would be an exceedingly large amount.

But a large self-induction in continuous current circuits not being objectionable,but useful, in equalizing the fluctuations of current, nobody could warrant the absence of a dangerous high self-induction.

Therefore, if by legislative restrictions the electric current circuits are to be regulated at all, the only possible and useful thing would be to supervise, by competent experts, just as in the case of high-pressure steam boilers, all the high-pressure electric circuits and all those low-pressure circuits, too, which do not *per se* (as alternating currents) warrant the absence of dangerous self-induction.

The Gilbert Club in England.

The inaugural meeting of the Gilbert Club took place at the end of last month in the rooms of the Society of Arts in London. A large gathering of representative electrical and other scientific men was present, the chair being occupied by Sir Wm. Thomson.

Prof. Silvanus Thompson, who was called upon by the chairman to explain the objects and constitution of the club, said that it had seemed to those who were instrumental in establishing it that there were quite scientific societies enough in the world without creating another. What that club proposed to do was to commemorate the tercentenary of William Gilbert and his work, and to do honor to him by reproducing in English the great work which began the science of electricity.

The objects of the club are clearly stated in the following resolution, which was unanimously adopted:

"That the objects of the Gilbert Club be as follows: 1. To produce and issue an English translation of 'De Magnete' in the manner of the folio edition of 1600. 2. To arrange hereafter for the tercentenary celebration of the publication of 'De Magnete' in the year 1900. 3. To promote inquiries into the personal history, life, works and writings of Dr. Gilbert. 4. To have power after the completion of the English edition of 'De Magnete' to undertake the reproduction of other early works on electricity and magnetism, provided at such date a majority of the members of the club so desire."

Subsequently Sir Wm. Thomson was elected president of the club; vice-presidents, Mr. Jonathon Hutchinson (president of the Royal College of Surgeons), Dr. Benjamin Ward Richardson, Lord Rayleigh, Dr. Henry Laver, of Colchester, Prof. Reinold (president of the Physical Society), and Prof. Hughes. The following gentlemen were elected to serve on the committee: Mr. Lant Carpenter, Prof. Ferguson, Sir Phillip Magnus, Prof. Rucker, Prof. Foster, and Prof. Forbes. Mr. Latimer Clark was elected treasurer, and Mr. Conrad W. Cooke, Mr. Raphael Meldola, and Prof. Silvanus P. Thompson, honorable secretaries.

This movement is evidently one that should find much sympathy in America, where Gilbert has a large number of admirers, one of whom, Dr. Park Benjamin, has published eloquent tributes to his memory. We believe that many electricians in America will be glad to join the club and to secure copies of the proposed translation.

Farewell Glimpses of the Paris Exposition.

Although we have already described a large number of the American exhibits at the Paris Exhibition, there are a few which still remain, and which deserve mention in our columns, not only on account of the intrinsic value of the exhibits themselves, but also on account of the enterprise shown by our American electrical manufacturers, the excellence of whose exhibits in nearly every case was recognized by the awarding of a prize. The accompanying group of illustrations shows several of these displays, the centre being occupied by an excellent representation of the exhibit made by the Commercial Cable Company. This exhibit, as will be seen, contained the latest form of the Cuttriss siphon recorder, in which the old mouse mill is done away with, the siphon being vibrated by electro-magnetic impulses. Just at the back of this were exhibited the various types of cable employed by the company, including the deep sea, shore end, and intermediate types. There was also shown the wonderful snarl illustrated in our columns some time ago, which was the result of the hooking and scraping of the cable by the anchor of a fishing smack. Beside this was the section of a cable which had been smashed by an iceberg grating along the bottom of the sea. At the left is shown a cabinet containing a complete set of Muirhead condensers, which combine within themselves a condenser and resistance, and which are now employed in duplexing the cable. At the right, inclosed by a glass case, is a beautiful model of the cable steamer "Mackay-Bennett."

Directly above this group is illustrated the original apparatus of Prof. Elisha Gray. Here is shown the original telephone of Prof. Gray, which has been the subject of so much controversy in telephonic circles in the past. Among the other inventions of Prof. Gray which were exhibited, were the harmonic telegraph apparatus, printing telegraph, and a number of others.

At the upper left hand corner will be seen the exhibit of the Okonite Company. This consisted of a pyramid built up of the various types of wires and cables made by this well-known house, andi llustrating very well the variety of their manufacture. The products of this company are so well known as to require no further description.

At the right-hand upper corner will be seen the exhibit of the Consolidated Telegraph and Electrical Subway Company, of New York, and that of the Cobb Vulcanite Company, of Wilmington, Del., which occupied adjoining spaces. The former exhibited sections of the various conduits which they build, which are now being put down in New York, and the walls of their exhibit were covered with drawings and figures explanatory of their system, and showing the manner in which the various styles of their conduit are constructed. The Cobb exhibit contained various samples of the interesting and ingenious Cobb vulcanite wire, in which the conductor is insulated loosely within the flexible vulcanite tubing.

The exhibit of the Electrical Supply Company of Ansonia and Chicago is shown in the lower left hand-corner. It contained a sample of nearly everything manufactured by that well-known firm, including wire insulators, batteries, annunciators and a large variety of their smaller pieces.

To the right of this will be seen the exhibit of the Elektron Manufacturing Company of Brooklyn. Here the various sizes and types of the Perret motor were shown, some in combination with fans, and the various parts of the machine were exposed, exhibiting the manner of construction.

The lower right-hand corner of our engraving exhibits the nook occupied by the American Institute of Electrical Engineers and the Electric Club of New York. Both these organizations had registers, in which many of the visitors inscribed their names, aud which will, no doubt, be preserved as interesting mementoes of the occasion. In this space the American Bell Telephone Company very generously provided one of their long-distance telephones, which was connected with the general exhibition service, and which enabled the visitors to communicate with each other with ease. Suspended on the wall, directly to the right of the telephone desk, will be seen one of the little domestic telephones designed by M. Abdank Abakanowicz, in which the transmitter and receiver occupy no larger a space than a good sized watch. On the wall also was hung a gong, placed in connection with the Gardner time service of the United States Naval Observatory. On the table in this exhibit there were on file the various electrical journals of this country, which kept the American exhibitors, as well as many others, informed as to electrical events here.

GLIMPSES OF AMERICAN ELECTRICAL EXHIBITS AT THE PARIS EXPOSITION.

The Realm of the Telephone Exchange Operator.

Mr. W. Steigelman, of the Missouri Bell Telephone Company, said recently: "There is no work so fascinating to women as operating in the central office of a telephone company. Very few of them ever leave the company because they are dissatisfied with the work. They go in, go through all the grades and the several increases of salary which fall to them under the length-of-service rules of the company, get married and resign. That is about the history of a telephone girl. The pay is very good, and some of them get $60 a month, but the work is very exacting. It requires constant attention, and the strain on the nerves is very great while it lasts. What the charm of telephone work to a girl is I don't know. I was asked once if it did not lie in the opportunities the position afforded to gratify curiosity. I am quite certain that isn't it. There is no time during the day when an operator is enough at leisure to listen to even a two-minute conversation, granting that she was inquisitive enough to try to do it. I have thought sometimes that it was that each young lady in the operating room feels that so long as she attends to her work properly she is sovereign in her own sphere, and is not annoyed by the captious criticism and unreasonable demands of superiors, which she would encounter in other places."

Electricians and Electrical Wires.

Without doubt the electricians are just now confronted with several difficulties which tend, in a greater or less degree, to retard the progress of electrical science in its way to practical success. The electricians, however, are not to be censured, says the Chicago *Journal of Commerce*, for these apparent failures in their efforts to perfect their work; for the subtle fluid has developed various peculiarities in its operations that still baffle its most expert manipulators. Neither can it be charged that the electricians have gone too fast in their struggles to overcome all the difficulties that hinder them. They have been assiduous in their studies and experiments, and have triumphed over many conflicting elements; but there is much more to learn, much more to conquer, much more to regulate, in their respective systems and methods; and we

believe they will eventually accomplish all this as thoroughly as they have subdued quite as formidable difficulties in the past.

The proper insulation of electric wires, when exposed above ground or buried in conduits, is one of the most important of the problems they are now called upon to secure.

Mr. E. P. Roberts on Electric Traction.

In an excellent paper on the above subject read by Mr. E. P. Roberts before the Altoona Mechanics' Institute, the author gave a number of valuable details on the operation

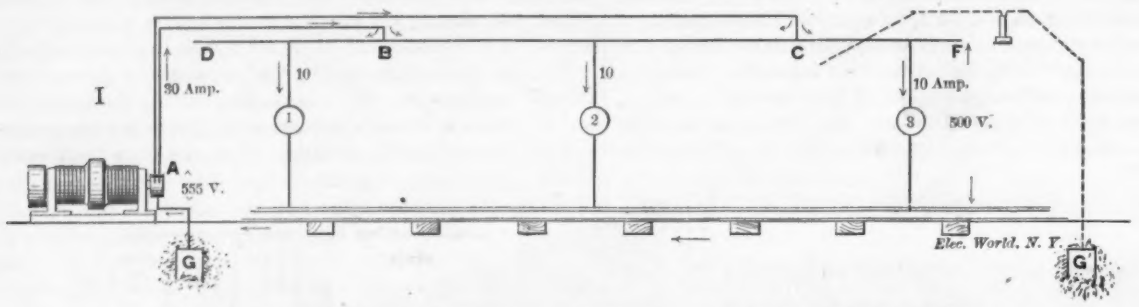


FIG. 1.—METHOD OF RUNNING ELECTRIC RAILWAY CONDUCTORS.

of the general types of electric railways now in use. Referring to the methods adapted for feeding the line, the author described several plans which have been adopted, as follows:

In Fig. 1 we see a diagrammatic representation of an overhead single conductor *D F* with wires *A B* and *A C* connecting the same with the dynamo. In this case the rails are all connected to a large copper wire leading back to a good ground at the station, and also sometimes by short wires to each other, and also the negative terminal of the dynamo. The motors are represented at 1, 2 and 3. If any one of the distributing wires breaks, the cars are not stopped, unless a good ground connection is made by the broken wire, n which case the dynamo is short circuited; that is, it has a path of practically no resistance made for the current, and the dynamo will, therefore, generate an abnormal amount of current. When this occurs an automatic device opens the circuit and the dynamo no longer suppplies current to the line. If the trolley wire breaks and falls on the track, a similar short circuit occurs. If it should not happen to make a ground, no interruption takes place until a car reaches the break, and then it must evidently stop.

If a telephone, or other wire, with a ground circuit,

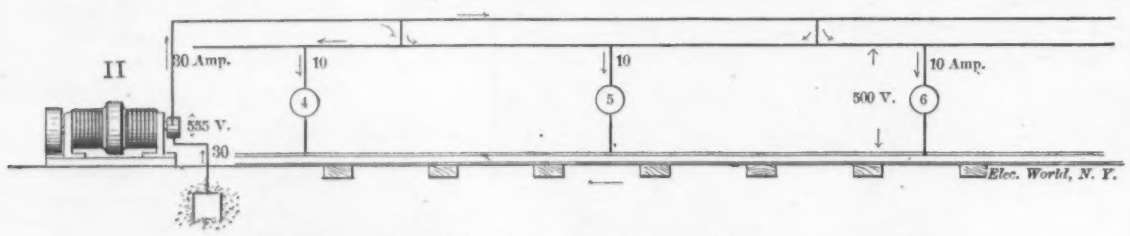


FIG. 2.—METHOD OF RUNNING ELECTRIC RAILWAY CONDUCTORS.

comes in contact with any portion of the overhead conductor, current will flow from the power circuit through the telephone circuit in amount depending upon the resistance of such wire between the point of contact and its earth connection. If a telephone be in such circuit it will be burned unless a safety device be arranged to protect the same.

In Fig. 2 we see a modification of the above system. A main wire is erected parallel to the trolley wire, and into this main a number of feeders supply current at different points in order that all parts of the system shall have, as nearly as possible, the same electrical pressure. The main wire is connected to the trolley wire at a number of points. The same observations as to breaks and grounds hold good for this case as in case one.

In Fig. 3 two overhead wires are used, and the current going out in one, returns through the other, no ground connections being used. If a distributing wire breaks, no injury to the operation of the system can follow. If a trolley wire breaks, the car stops when it reaches the break. If a telephone wire falls across one wire, and the conductors of the railroad are well insulated, there is no effect. If the wire falls across the two railroad wires, the dynamo is short circuited, and either such intruding wire is burned apart or the safety device of the dynamo opens the circuit.

Fig. 4 shows the series system. If any live wire, that is, any wire through which current is passing, or is in electrical connection with the dynamo, breaks, the dynamo line is opened, and the dynamo ceases to generate current. If a telephone wire drops on one wire, nothing results; if on two adjacent wires, nothing occurs until a car reaches such section; then the motor is short circuited, and, being robbed of its current, stops until the obstruction is removed. If two grounds, such as at *X* and *Y*, occur, no effect is produced, with the exception that the telephone subscribers would be connected without permission of the telephone company, until

The Alabama Telegraph Tax Case.

The Supreme Court of the United States has rendered a decision in the case of the Western Union Telegraph Company against the Secretary of State of Alabama and other State officers, brought on an appeal from a decision of the Supreme Court of Alabama. The question involved is the constitutionality of a law of Alabama imposing a tax upon the gross receipts of all telegraph companies for business done within the State. Under this act the telegraph company was taxed not only on business done entirely within the State, but on messages sent to or received from other States. This court, in an opinion by Justice Miller,

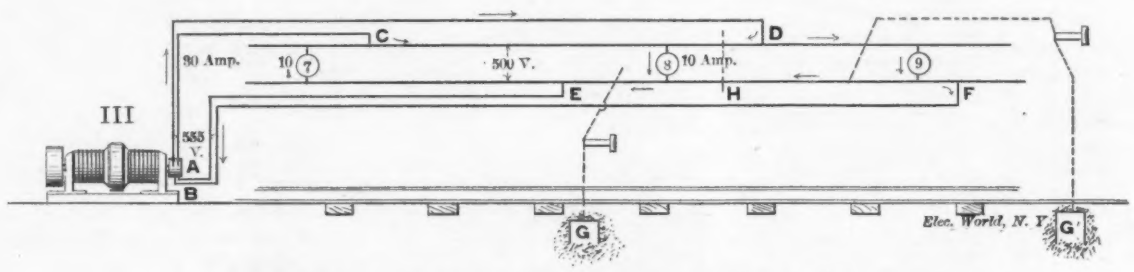


FIG. 3.—METHOD OF COMPLETE OVERHEAD METALLIC CIRCUIT.

says that it is hardly worth while to make any discussion about the matter, as the court has six or eight times, within as many years, decided that messages sent from one State into another are not subject to taxation, because it would be an interference with interstate commerce. Judgment reversed.

Comparison of Solar Radiation with that of the Arc Light.

In an admirable memoir on "The Temperature of the Moon," by Prof. S. P. Langley, assisted by Mr. F. W. Very, appearing in the December numl er of the *American Journal of Science*, the authors record the following series of observations on the comparison of the intrinsic intensity of solar radiation with that of the electric arc in different parts of the spectrum:

This observation of the comparative intensity of the sun and the electric light is given in the original memoir only so far as to show that it brings independent evidence of a large atmospheric absorption of the extreme infra-red rays and enables us to estimate approximately the amount of this absorption at each point in the spectrum. The observations were not repeated to obtain such a thorough comparison as would be desirable. As they have never been printed, however, and since, as far as we know, none other such exist, we will give them here under the caution that they are to be considered only first approximations. The light was that from the pit of the positive carbon of gas coke, one inch in diameter, with the current derived from a dynamo, actuated by an engine of ten horse power, and therefore certainly at least as intrinsically hot and bright as any smaller arc light in more common use, and presumably much more so. The apparatus was that already described in the memoir "On Hitherto Unrecognized Wave-lengths."*

The following table gives the observed galvanometer deflections after applying a multiplying factor for the shunt, which had to be used for the larger readings:

1	2	3	4	5	6	7
Deviation Rock Salt 60° Prism.	Wave-Length.	Observed deflection *sun* after absorption.	Observed deflection *arc*.	Calculated deflection *sun* without absorption.	Observed ratio sun and arc.	Calculated ratio of unabsorbed sun and arc.
deg. min.	μ	div.	div.	div.		
43·53	0·373	7·5	1·3	34·	5·77	26·0
43·17	0 398	11·5	1·5	38·	7·67	21·8
41 54	0·489	33·5	5 3	60·	6·32	14·4
41·05	0·587	104·0	10·5	115·	9·90	11·1
40·45	0·663	204·0	22·0	204·	9·27	10·0
40·27	0·749	432·0	43·5	450·	9·93	9·1
40·05	0·96	1 073·0	215·0	1 763·	4 99	8·2
39·54	1·13	1 783·0	459·0	3 534·	3·88	7·7
39·20	2·87	1 905·0	882·0	5 645	2 16	6·4
39·00	4 3	521·0	235·0	1 363·	2·22	5·8
38·45	5·6	75·0	157·0	832·	0·48	5·3
38·00	10·4	19·5	39·0	156·	0·50	4·0

The result of the comparison of the (of course unabsorbed) electric arc with the radiation of the sun after absorption, as shown in the sixth column, is that this solar radiation in the orange and red is nearly 10 times that of the arc, while toward the violet end of the spectrum the relative superiority of the absorbed solar heat diminishes, evidently because of the progressive increase of the atmospheric absorption in that direction, which lessens the solar intensity without sensibly affecting that of the arc. The solar efficiency continues greater through all the infra-red spectrum known until very lately, while in the extreme portions recently investigated it falls below that of the arc. This is partly due to the fact that radiation from a source at a lower temperature (the arc in this case) is relatively more powerful in the longer than in the shorter waves; yet it can hardly be doubted that here also (that is, in the *extreme* infra-red) a very large atmospheric absorption has taken place.

There is reason to believe that a considerable part of this absorption takes place in the first few metres of air, while we conclude, from all the evidence in our possession, that the real telluric absorption, being a locally selective one, is

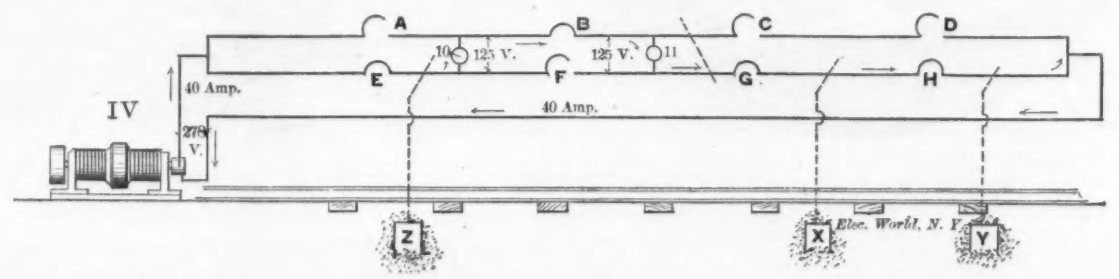


FIG. 4.—SERIES METHOD OF RUNNING ELECTRIC RAILWAY CONDUCTORS.

much greater than the comparison of high and low altitude observations alone would indicate.

The import of this comparison will be still more evident from a consideration of the seventh column, where, by means of the Allegheny tables of the solar absorption, we have calculated the ratio of the arc heat to that of the sun before absorption by the earth's atmosphere. Although a large absorption by the solar atmosphere has already taken place, we see that in the ultra-violet the solar radiation is from 20 to 30 times that of the arc, while that of the absorbed sun is only about six or seven times. When we reach the region of the red and upper infra-red, we see that these ratios are nearly the same in the absorbed and unabsorbed solar radiation, showing that the terrestrial absorption in this region (which was once supposed to be its principal seat) is in fact very small, while in the regions of the extreme infra-red, corresponding to temperatures not greatly exceeding that of the terrestrial soil (regions only

*See *American Journal of Science*, XXXII. August, 1886.

revealed by quite recent investigation) the telluric absorption again becomes considerable.

The general result of this comparison is to enhance our ideas as to the rate of solar radiation, and as to the solar temperature. Comparisons of the total solar radiation with the total arc radiation have (it may be observed) been made before, but so far as I am aware, comparisons of the heat in different portions of their spectra are here presented for the first time.

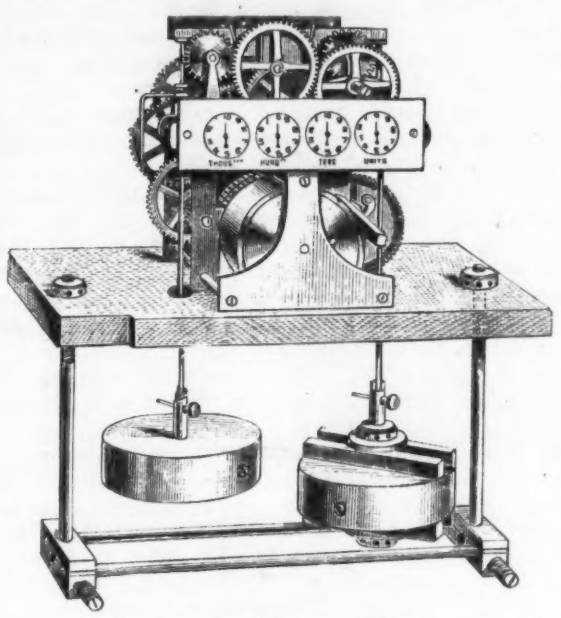
The Oulton-Edmondson Electricity Meter.

This meter consists of a clock having two independent torsion balances, or torsion pendulums, which are set to vibrate in identical time when no current is passing. One of the balances carries two or more permanent magnets placed astatically; above, between or beneath which is a conductor, carrying the current to be measured. Before the clock is started, and when the escapements are at the zero point, the magnets stand at right angles to the conductor. When the clock is running, and the current is passing along the conductor, it exerts a quickening or retarding influence upon the magnet-carrying balance, according to the direction of the current. The difference between the speed of the magnet-carrying balance and the other balance is recorded on dials, through a differential gear of novel construction and a registering train. The balances are set to the rate of about 15 vibrations to the minute, and the instrument is calibrated to give a variation between the time of the two balances of one vibration per hour for one ampère hour, and the readings are proportional to the current through a very wide range. It will measure the smallest current. The meter is calibrated in ampère hours, each division of the unit's dial indicating 10 ampère hours, or one Board of Trade unit, if the E. M. F. be 100 volts. One of the wheels in the registering train is a "change wheel." It has 100 teeth (corresponding with an E. M. F. of 100 volts), and can be changed for one with any other number of teeth up to 120, when the register will indicate Board of Trade units at an E. M. F. corresponding with the number of teeth in the wheel. This change wheel is, therefore, termed "the volt wheel." The meter is contained in a wooden case, measuring 15 inches high, 13 inches wide and 6½ inches deep, and the whole apparatus is exceedingly compact and portable.

According to the London *Electrician*, the meter possesses several advantages over other meters, which measure the currents by the difference set up in the time of two clocks. It is much more compact. The balances being parts of one clock, and being driven by opposite ends of one and the same spring, are less liable to set up a difference of time than if belonging to two separate clocks, and therefore driven by two separate springs. Only one winding is required, and if the clock be allowed to run down for want of winding, both balances stop together instead of one of them going on and registering at a great rate for, or against, the consumer, as has sometimes been the case in meters consisting of two separate clocks. By using "torsion" balances the clock can be run at a very slow speed, so as to require winding up only at long intervals. It can be made to run for any time from three months to one year. The torsion balance is so suspended as to be little, if it all, affected in its action by external vibrations, and it will work satisfactorily in positions in which a pendulum would be stopped.

Variations of temperature equally affect *both* balances, and consequently do not affect the record, as only the *difference* of time between them is registered. The use of magnets mounted astatically tends to preserve their magnetism from variation, and reduces the range of external influences. The loss of E. M. F. in measuring the current is inappreciable in its passage through the short straight conductor, which gives ample force for the measurement.

The calibration of the instrument is easily effected by passing a constant current through the copper rods, and varying their distance from the magnets. To convert the meter into a wattmeter all that is necessary is to substitute fine wire coils for the permanent magnets, in which case the instrument can be used for alternating as well as continuous currents.



THE OULTON-EDMONSON METER.

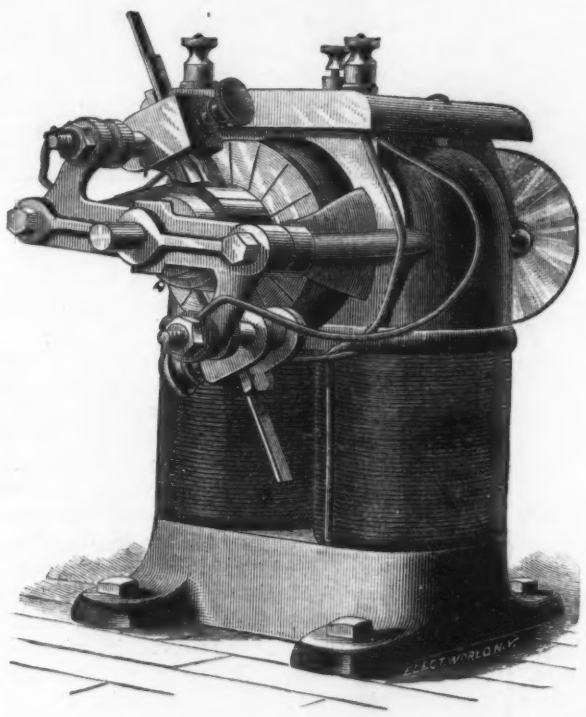
The Arnold Motor and Bell Tapper.

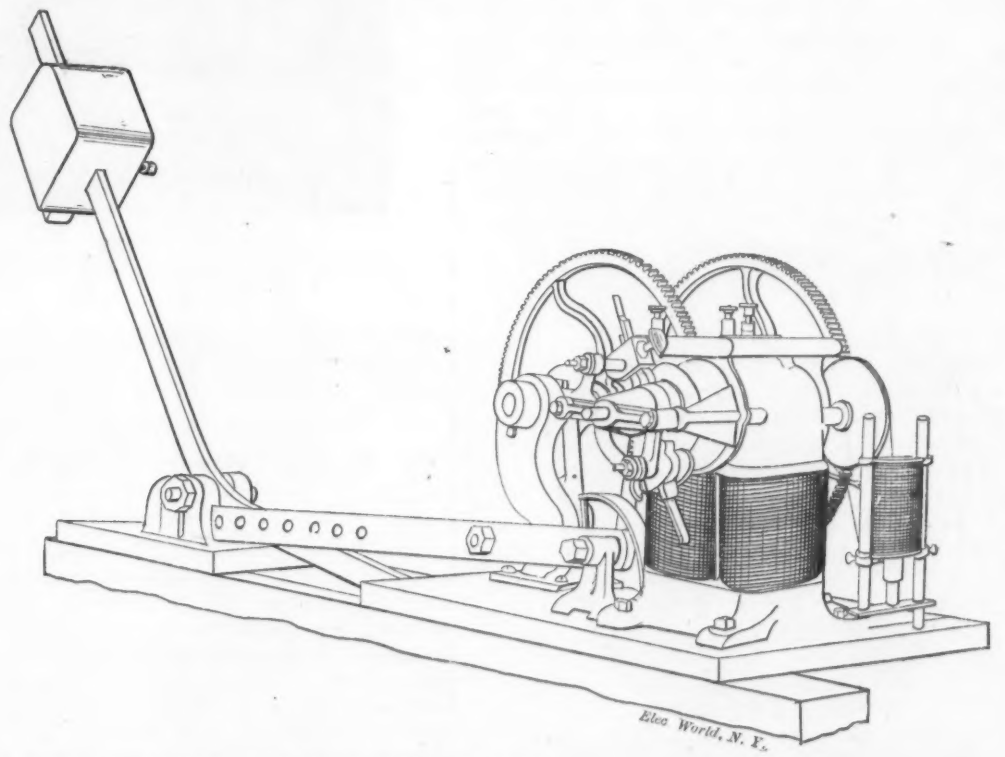
Among the electric motors which have recently been brought out is that illustrated in the accompanying engraving, Fig. 1. This machine, which is built by Messrs. Craig R. Arnold & Co., of Chester, Pa., is of 8 h. p. capacity, and has an armature of the Siemens type with the coils wound in parallel. The field is of the ordinary shunt form, but has, in addition, a series coil which is thrown in on starting the motor, so as to create a field, and prevent too great a rush of current. When the motor has attained its normal speed, the series coil is cut out, thus leaving the motor as a pure shunt machine. The trouble frequently attending the use of copper brushes has been avoided by the use of carbon brushes, with which all the motors of the firm are now provided.

These motors are built in various sizes, and a very interesting application to the fire alarm system of Chester, Pa., has been made with one of them. The installation is represented in the engraving, Fig. 2. As will be seen, the motor is mounted on a bed plate and operates a train of gear wheels. On the shaft of the last wheel is fastened a cam, which, as it revolves, depresses the rod by the roller, the nut of which is shown. When the motor revolves the bar is depressed and the weight is raised until the cam passes the roller, when the weight drops and strikes the bell.

In practice a general alarm is first sounded, and, after an interval of time is passed, the number of the ward is given.

It was found that in giving one or two strokes to designate a ward, the momentum of the motor carried it over and struck more. It then became necessary to devise some means of braking the motor as soon as the current was shut off. To effect this, a wheel, with a groove turned on it, was placed on the motor shaft, over which was passed a steel wire, one end of which was fastened to a lug, cast on a solenoid placed beside the motor, as shown. The other end of the wire was fastened to a core or rod of iron in this solenoid. A stiff spring keeps the bar down tight, and the tension holds the motor still. This solenoid is placed in multiple with the motor, and as soon as the current is turned on, the core is lifted, thereby removing the tension, and allowing the motor to start promptly. The machine is capable of delivering 40 blows per minute.





FIGS. 1 AND 2.—THE ARNOLD MOTOR AND FIRE BELL TAPPER.

Electric Lighting in Paris.

In the "Notes on the Paris Exhibition," appearing in our issue of Oct. 12, our special correspondent described the electric light installation undertaken by the city of Paris, which was then nearing completion. This station, situated in the Halles Centrales, was recently started in true Parisian style. The opening ceremony was performed by M. Yves Guyot, chairman of the Paris Municipal Council, and was the occasion of a brilliant fête, with festivities and dancing kept up all night. The streets were lighted with some 2,000 lamps. Both direct and alternate currents are employed, as described in the article above referred to. The Municipal Council wish to satisfy themselves thoroughly as to the comparative cost of the two systems, and it is understood that they intend eventually to increase the output of the station to 1,000,000 lights. The light is already so much in demand that it will be necessary very shortly to increase the plant, and a credit of a million and a half francs will, it is thought, be asked for. It is interesting to note that this is the first occasion on which the Municipality of Paris have directly themselves undertaken the working of any manufacture or business.

Disturbances on Telephone Circuits.

At the last meeting of the National Telephone Society in London, Mr. Arthur E. Cotterell read an interesting paper on the above subject. Among the causes to which Mr. Cotterell assigned the disturbing effects experienced on telephone lines may be mentioned microphonic action due to unsoldered or "bad" joints, earth currents travers-

ing the lines, induction due to adjacent earth plates, galvanic action, the result of using earth plates of dissimilar metal, and, of course, the ordinary induced effects due to currents from adjacent wires. Mr. Cotterell said he had found that in a cable induction decreased almost in proportion to the number of wires in the cable having a "ground" connection at each end, from which he inferred that cables with as large a core as possible "earthed" at either end would be most suitable. A metallic earthed sheathing on the wires has a very beneficial effect. He relates a curious instance as worthy of further investigation, where the induction on two adjacent private wires was materially diminished by severing the pole earths. With regard to metallic circuits, he pointed out the useful effects derived from having a metallic sheath on the induction coil where a loop is joined to a single wire, and the necessity of keeping both arms of the loop line equally balanced to avoid the bad results recently obtained through one of the arms of the metallic circuit between Birmingham and the North of England having a bad joint.

The New Barriett Motor and Dynamo.

The accompanying engraving represents the new constant potential dynamo and motor designed by Mr. Samuel Barriett, of Brooklyn. The frame of the machine is cast of soft gray iron, the cores of the field magnets being of Norway iron, by the use of which a very strong field is obtained, so that an armature of low resistance can be employed. This feature enables constant speed to be maintained under varying loads. The armature is a modification of the Siemens' drum type, and has two layers of wire wound in 48 sections.

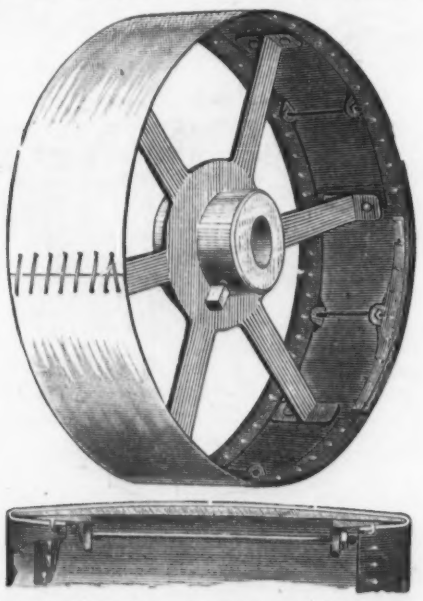
The Barriett Motor.

One of the novel features of the machine is the self-oiling device which is operated entirely by magnetism. The armature spindle runs in a brass bushing directly over an oil box placed in the base of the machine, and in which are placed a pair of soft iron discs. When the motor circuit is closed, the slight magnetism of the base magnetizes the soft iron discs, which are attracted by the steel spindle of the armature, and are held up against the spindle and rotated by friction against the latter. The discs dip into the oil in the box, which it continually carries up to the bearing, the oil returning through an oil chamber to the box below. In this way a single oiling every month suffices to keep the machine lubricated.

The resistance of the armature of a ½ h. p. motor is ½ ohm and that of the field 320 ohms. A test of this machine was recently made at the Edison station in Pearl street, this city, in which an efficiency of 90 per cent. was obtained. A similar test made in the Brooklyn Edison station showed like results, and a number of these machines have been introduced on the Edison circuits there. The machine is built by the R. & B. Electric Manufacturing Company, of Brooklyn, N. Y.

The Shultz Leather-Covered Pulleys.

Heretofore, in covering pulleys with leather, it has been customary to drill holes in the face at each edge of the pulley and rivet the leather on; but in covering a pulley in that way, it is impossible to keep the air from getting under and eventually breaking it out at the rivets. Besides, so many rivets being necessary to cover a pulley they prevent the proper adhesion of belt to pulley and also cut out the belt.



Shultz Improved Pulley for Dynamos.

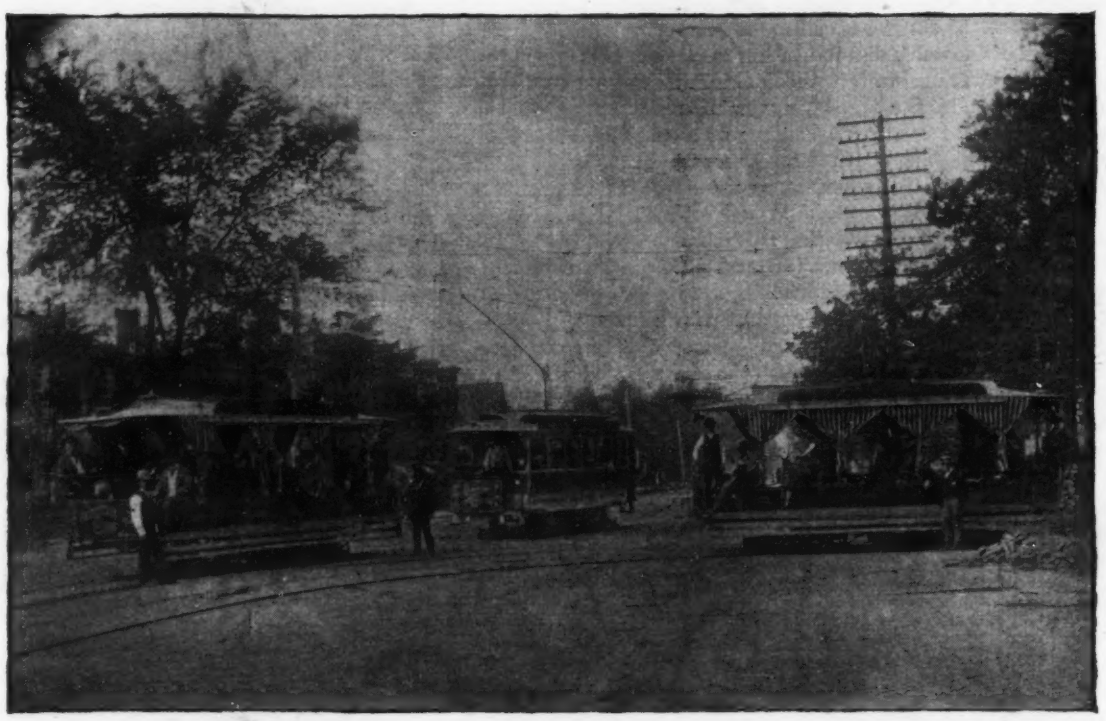
To avoid this difficulty, the Shultz Belting Company, of St. Louis, Mo., have devised a simple arrangement, which is shown in the accompanying engravings. As will be seen, the covering is made wider than the pulley face, its edges being brought over the edges of the rim, and then turned toward each other and fastened on to malleable iron segment clamps, with teeth to hold the leather; the clamps are placed around the pulley under the rim and are drawn together by a quarter-inch bolt, which draws the leather tight over the face and edges of the pulley. In this way the leather can be drawn on the face of the pulley as tight as a drum-head, and should the covering ever become loose, it can be tightened in a few minutes simply with a screwdriver to turn the bolts. The pulley being so perfectly covered, the belt wears much longer; besides, a leather-covered pulley will drive 50 per cent. more than an iron-faced pulley; belts can also be run slacker, preventing heated journals and wear and tear on machinery.

The covering can be applied to any pulley, and the covering, clamps and bolts are furnished by the manufacturers.

The Electric Road at Decatur, Ill.

The Citizens' Electric Street Railway, Decatur, Ill., changed from horse power to electric motors August 27, 1889, and has since been in successful operation. The road is five miles in length, of which 2,500 feet is double track. On the double track 40-pound T rail is used and on one mile of single track the Wharton girder rail, the remainder being laid with 25 and 30-pound T rail.

The overhead system has been used throughout, the main conductors being suspended from cross wires from poles placed on each side of the street at a distance of 125 feet apart. The maximum gradient of the road is five per cent., with several ranging from this to three per cent. The cars are eight in number, and are each equipped with one 15 h. p. Thomson-Houston motor. They are in operation 18 hours a day, and make on an average about 105 miles each. The power station is a one-story brick building, 40 × 80 feet, and contains two 125 h. p. engines, two 80 h. p. Thomson-Houston generators and switchboard with necessary fittings. The boiler room is 30 × 40 feet, and contains two 100 h. p. boilers. The car house is a two story frame building 50 × 120 feet, having five tracks, two of which have pits extending their entire length. These pits are 3½ feet deep and have brick sides and cement floors, and are used for oiling and cleaning the motors. Since electricity has been adopted the travel has increased 100 per cent.



THE ELECTRIC ROAD AT DECATUR, ILL.

Mr. Tesla's Principle of Designing Motors.

BY A. GAILLARD.

I beg to make a slight remark concerning Mr. Tesla's novel principle of constructing electric motors as described in your issue of Dec. 14. You say: "Mr. Tesla reasons that in any motor the total energy supplied to do the work is equal to the sum of the energies expended in the armature and the field. The power developed, however, is *proportionate* [not more] to the product of these quantities." It is added that this product will be greatest when these quantities are equal.

Very well, this states the fact that two numbers of constant sum give a larger product when made equal. But that we are not concerned in, as what we want is to have not that product to be the largest, but the product of that product by another quantity, which is variable for every system of values of the energies at work in the motor.

In the example given we can easily see how the quantity referred to comes in. Let us assume, as you do, that the energy as represented in the magnetism in the field of a given motor is 90, and that in the armature 10. The sum of these quantities, which represents the total energy expended in driving the motor, is 100.

Now, calling a the quantity to which the power developed is proportionate, we can equate the energies corresponding to the supplied and expended energies as follows:

$$\underbrace{90}_{\text{(spent in field magnets)}} + \underbrace{10}_{\text{(spent in armature)}} = \underbrace{(90 \times 10)\,a}_{\text{(power developed).}}$$

If we suppose that the efficiency of the motor is perfect we see that a is here equal to 1.111. Taking now the second case, in which the field and the armature each consumes 50, we have:

$$\underbrace{50 + 50}_{\text{(power supplied to the motor)}} = \underbrace{(2{,}500)\,a}_{\text{(power furnished by the motor);}}$$

but it is evident that here a can never be equal even to $\frac{1}{25}$.

Consequently, this factor a has not to be summarily thrown aside, even in the most novel principle of constructing electric motors.

Street Railway Franchises.

The Indianapolis *Journal*, in referring to the value of a franchise in that city, says:

The Superior Street Railroad Company, of Cleveland, had a twenty-years' charter, but on putting in electricity it was renewed for twenty-five years. The company is required to pay a license of $10 annually for each car operated, but it is not held to any obligation to improve the streets except between rails. This does not include the strip between double tracks.

The Memphis Street Car Company was given a charter for fifty years on condition that it keep in repair the street between rails and for two feet on each side of the track. It is not required to lay new pavements, but it pays a license of $20 a car annually.

The Citizens' Traction Company in Pittsburgh has a good thing in a perpetual charter, without any burdens except to keep clean and in order the street between its tracks, for one foot each side of them.

In Milwaukee the Cream City Railroad Company paid a tax of $10 annually up to 1887, when it was required to pay $15, and that amount is for each car put into service during any one year. The company is also required to keep the streets in repair between rails, including centre space between double tracks, and for one foot each side of the tracks. As to paving, the city furnishes the material and labor and the company has the grading done.

The charter of the Central Passenger Company, in Louisville, was granted in 1866 for 30 years. A $25 license on each car was paid and the streets kept in repair, but the license was advanced to $50 a car. In view of that increase the city relieved the company of any burden as to improvements and repairs on the streets.

The Metropolitan Street Railroad Company, of Kansas City, has a thirty years' charter, and pays a $25 car license. It is required to pave and repair street between tracks and for 18 inches each side.

The Omaha Horse Railway Company has a 40 years' charter for which it now paves between tracks on any paved streets. Two years from now it will be compelled to pave, also, one foot each side of its tracks. The Electric Railway Company of that city has a 40 years' charter, for which it pays no car license or tax.

An Opportunity in the South.

A leading electrical company was recently in receipt of the following quaint communication:

"At this writing I make you a little statement in reference to advice and information. I have seen many electric companies advertised. I think your machine is the only complete and most thorough method of artificial light. For a great number of years my whole thoughts have been deeply involved in putting plants into small country towns to furnish private citizens with small bulb lights for the price of oil. As one central station dynamo will furnish

many rooms, or bulbs, I think it could be made a paying thing at 5c. (five cents) a week for bulbs. I have not been financially instrumental heretofore, or I would have tried it. I will make a plain statement to you in reference to make some honest sales for you as neat as I can. I can give you my reference as to men of whom I borrow small amounts without security. There are many country towns here, of five hundred and more, which never seen an electric light. I think I can put it into several small town and run it successfully. I would like you to come to some terms to supply these machines for me, if you possibly can. In this wooden country of ours, there are many swift currents,

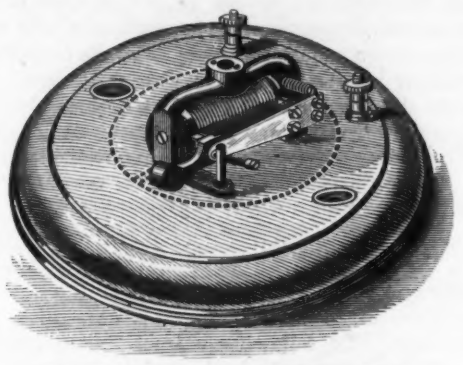


FIG. 1.—THE BERRY ELECTRIC BELL.

which could be converted into valuable mill sites. Will you value a small tract, whatever size or cost in the least, a security. I will try and furnish a good locality, provided you will furnish all cash at 8 per cent. interest, to build a dam, house, and put in a complete outfit, underground style. Small lamps are about all I want. Can you give me some idea of what the main and casing will cost a foot, or about what it will cost a foot complete? Can you give me some idea about what your material will cost and labor for construction? It will not take long to pay up where there are several large plants in a different place. I would be pleased to hear from you shortly, if there has ever been anything like that ever operated. I think I could put a 50 or 100-light machine for a small start in each town. My opinion is this, to measure it at the rate of five cents per week, a bulb, in your measure machine. It is about as well to put in a large one as a small one for cheapness. I may be able to get you a discount on turbine wheels, at least I will try my best. I would like to work up a good thing for you. A small cheap building is all I want. You can get ditchers here at 75 cents a day to lay the wire. I would be pleased to hear from you and see what terms can be made provided a suited pond can be had. Here they would hoot at me for mentioning such a thing. If you cannot comply with this offer asked, what will you allow me on the different machines I can have bought? I prefer your company putting in the whole plant."

The Berry Electric Bell.

In order to reduce the space occupied by the usual call bell, as well as the battery power required to operate it, Mr. F. H. Berry, of London, has recently brought out the device shown in the accompanying engraving, Fig. 1,

FIG. 2.—THE BERRY ELECTRIC BELL.

which illustrates the working parts. As will be seen, but a single magnet is employed, with iron cheeks, the latter forming the two poles of the magnet which attracts the small armature that strikes the bell. As there is but one bobbin, instead of two, it offers only half the resistance, and hence a single Leclanché cell is sufficient to operate it, The engraving, Fig. 2, shows one style of mounting of the bell, which is largely in use in England.

Gethins' Improved Gravity Battery.

There is probably no type of voltaic battery which has attracted the attention of inventors and electricians more than the Daniell cell. Theoretically, it presents perfect conditions of constancy in its action, and hence has continued to hold its own against many other forms. The introduction of the gravity type of this cell, hough a considerable advance over the original porous cup type, is, nevertheless, still accompanied by some disadvantages, principal among which is the frequent heavy local action, due to the mixing of the two layers of liquids. In order to remedy this, Mr. J. L. Gethins, of Boston, has introduced a porous partition; but instead of making it in the form of the old vertical cup, separating the liquids, the arrangment is such that the gravity principle is retained and assisted by the interposition of a *horizontal* partition between the layers. The liquids thus have a sharp line of division and their intermingling is thus effectually prevented.

The accompanying engraving, Fig. 1, shows the cell complete. The porous jar, shown separate in Fig. 2, is provided with a rim which acts as a support, the whole resting on the upper edge of the glass jar. The zinc electrode shown in Fig. 3 rests on the bottom of the partition.

The use of the cell over extended periods has demonstrated that no filling of the pores of the partition with copper takes place; and that in several instances a year's constant work was effected with a single charge of 4 pounds of copper sulphate and the consumption of 1½ pounds of zinc. The E. M. F. of the cell is 1.07, and its internal resistance about 3 ohms.

The battery is made by the Gethins Electrical Manufacturing Company, of Boston, Mass., and has been adopted by the Boston fire alarm and police signal system, in which service alone 2,200 cells are employed. They are

FIG. 1.—THE GETHINS GRAVITY BATTERY.

also employed in the fire alarm departments of Newark, N. J., Lowell, Mass., Framingham, Mass., and other places.

Queries Answered.

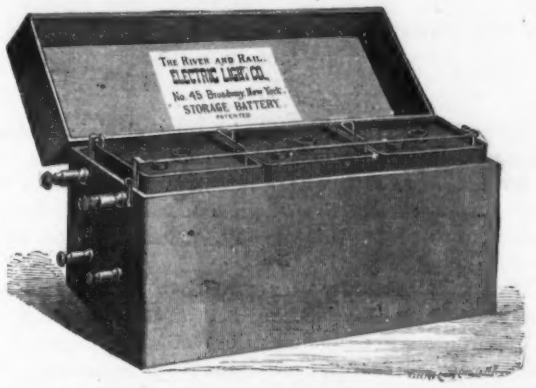
To the Editors of The Electrical World:

Will you kindly inform me through your columns of (1) the number of the wire used in both the primary and secondary coils of a Hughes induction balance? I can find nothing relating to the number of the wire in above coils in any books. (2) Why two sets of carbons are used in some systems of electric lighting. (3) The theory of two electric bells or two coils of any kind, of different resistance, in series, why the high resistance coils get the current, while the low resistance do not—*i. e.*, it does not magnetize the iron core, notwithstanding the current is passing around it. (4) Why should the resistance of instruments be equal of that of the line. A SUBSCRIBER.

ANSWER.—1. Use No. 32 silk-covered wire. 2. Two sets of carbons are employed in order to avoid the re-carboning which would be necessary were but a single pair used on a circuit burning longer than the time in which one pair is consumed. 3. The magnetic strength of an electromagnet depends, within limits, upon the number of ampère turns, *i. e.*, the product of the number of ampères by the number of turns of the wire. Hence it is that of two coils having the *same* current passing through each, the one having the greater number of turns will be more strongly magnetic than the other, notwithstanding its higher resistance. The placing of the coils in series necessarily involves their receiving the same current. 4. This rule, which, however, is not always followed in practice, results from the fact that by such an arrangement the magnetizing effect of the current in the instrument is the greatest with a given battery.—EDS. E. W.

The River and Rail Medical Storage Battery.

The use of electricity is constantly on the increase by physicians, not only as a therapeutical agent, but as a means of cautery and for the purpose of obtaining light for surgical operations and examination of the cavities of the body. To meet the want of a portable and sufficiently powerful battery, the River and Rail Electric Light Company, have arranged the set shown in the accompanying engraving. These are made in two sizes, with cell of different capacity, the larger weighing, complete, 29½ pounds, and



RIVER AND RAIL STORAGE BATTERY SET.

capable of maintaining a 4 c. p. lamp lit for twenty hours; and a smaller size weighing but 14½ pounds, and capable of maintaining a similar lamp for ten hours. The cells employed are manufactured under the patents of Prof. Wm. Main and Mr. A. V. Meserole.

Resignation of President Gilliland, of the New York Electric Club.

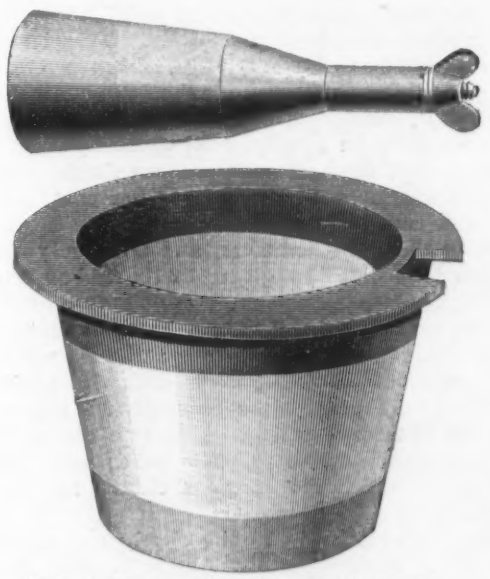
At a meeting of the Board of Managers of the New York Electric Club, held on Dec. 19, Mr. E. T. Gilliland, president of the club, tendered his resignation, on account of ill-health, in a letter expressing his deep interest in the club and its future work, and inclosing a pledge of substantial financial aid.

The following resolutions were thereupon unanimously adopted by the Board of Managers:

Resolved, by the Board of Managers of the Electric Club:

1st. That we learn with extreme regret of the illness of our honored president, and while accepting the resignation which his illness compels, we desire to testify to our appreciation of his earnest work in behalf of the club, and to express our thanks for the substantial subscription which accompanies his letter of resignation, and which is only one of the many favors the club has received from him. We sincerely hope for his early restoration to health.

2d. That, desiring not to lose Mr. Gilliland's valuable assistance on this board, should he be able to meet with us



FIGS. 2 AND 3.—THE GETHINS BATTERY.

on his return from the South, we unanimously ask him to remain as a vice-president of the club.

Mr. O. E. Madden was unanimously elected president of the club to fill the unexpired term.

The following resolutions were also adopted by the Board upon the deaths of Mr. E. N. Dickerson, vice-president, and Mr. M. W. Goodyear, member of the Board:

Resolved, That in the death of Vice-President E. N. Dickerson the Electric Club loses a valued and highly-esteemed officer, a gentleman of great ability, scientific attainment and vast general information, and whose kindly nature made him the friend of every one, and every one his friend who had the pleasure of his acquaintance.

Resolved, That this resolution be spread upon the minutes of the club, and a copy of the same be suitably engrossed and forwarded to the family of the deceased, and also that copies be furnished to the principal electrical and scientific papers.

Resolved, That in the death of Miles W. Goodyear this Board has lost one of its most earnest, intelligent and

popular co-workers; one who has ever labored enthusiastically for the best interests of the club, which he helped to organize. We found him ever faithful and true, and keenly and deeply regret our loss.

Resolved, That this resolution be spread upon the minutes of the club, and a copy of the same be suitably engrossed and forwarded to the family of the deceased, and also that copies be furnished to the principal electrical and scientific papers.

On the "New" Principle of Constructing Electric Motors.

BY C. O. MAILLOUX.

There are probably many designers of electric motors to whom the "new principle" advanced by Mr. Nikola Tesla, in a recent issue of The Electrical World, will be of no great surprise, unless the surprise consist in finding the statement thereof at this late day, unaccompanied by the proper limitations.

That "circumstances alter cases" is one of the first things that the electrical engineer realizes, and quite strongly, too, in undertaking to design electric motors for various purposes. He soon learns, indeed, that the designing of an electric motor is literally the solution of a very complex problem, involving numerous factors, which, to use a mathematical phrase, are functions of almost countless "independent variables."

To enumerate a few of the conditions only, the designer has such things as the source and character of current supply, the kind of work, the capacity, speed, range of load, regulation, efficiency, weight, size, space occupied, mechanical simplicity, and cost of construction of the motor to keep before his mind in designing.

Considered with reference to each particular case (which must of necessity be done), these requirements might be classed (in order of relative importance) in three groups, viz., indifferent, desirable and indispensable. The "grouping" is, moreover, different for each case, and the relative positions of various conditions may even find themselves reversed. Thus, for example, in a stationary motor, smallness of size and reduced weight are of relatively indifferent consideration, but in a street-car motor they are indispensable requisites.

These changes of relative importance react upon the design, and though not necessarily influencing the *type*, they do control absolutely the *proportions* and engineering details. Now, the relative and respective proportions of field magnet and armature in a given motor are among those factors which must be considered as "dependent" upon the requirements just noted. According to the relative importance ascribed to the requirements, or according to their "grouping," as just stated, this proportion will vary.

It depends largely upon which of the desirable qualities the designer concludes to sacrifice, in order to secure what is on the whole the most expedient and advantageous for any particular purpose or application. Thus in 1883 we were informed on good authority—Professors Ayrton and Perry—that the magnetic proportions of a motor should be 90 per cent. armature and 10 per cent. field magnet. In 1887 we learn on equally good authority—Mr. W. M. Mordey—that the proper proportions should be just the reverse, or 90 per cent. field and 10 per cent. armature. Mr. Tesla now claims that the right course lies halfway between these two extremes, and that the proper proportion is obtained by giving to the field and armature equal magnetic moments.

Now, the fact is, that if we take these statements broadly, in the abstract, they are all wrong; whereas when taken in the concrete, or in other words, each with reference to a specific "grouping" of the conditions and requirements, they are all three quite right. Hence we cannot consider any one as the whole principle but as being, rather, a principle on which the design of electric motors should be based.

This whole matter was quite clearly and forcibly put forward in England by Mr. Albion T. Snell in a paper entitled, "Notes on the Design of Electric Motors," read Jan. 16, 1889, before the City and Guilds Old Students' Association. This paper, let me say in passing, constitutes, together with the discussion thereon, one of the ablest recent contributions to the knowledge of the theory and practice of electric motor design, and would have been well worth reprinting in American journals.

Mr. Snell, speaking from an experience gained in connection with the design of some 400 motors, ranging from $\frac{1}{10}$ to 100 h. p., shows that the proportions depend on many conditions and circumstances, and that no absolutely fixed rule can be determined; that incidental or accidental questions of cost and mechanical construction, etc., may vary the proportions, as the size and capacity of the motor vary. In some cases he would grant that Mr. Mordey was right; but in others he would go in the opposite direction with Professors Ayrton and Perry. If, as we presume, we can take the "Immisch" motors to represent the practice of the doctrines he preaches, he does not, it would seem, approach either extreme, but oscillates, as it were, on either side of the halfway course. This is because he lays great stress upon "weight efficiency," and designs his motors from the *torque* or turning moment, as a starting point.

This "groups" the requirements in nearly that relative order which calls for equal moments in the field and armature. This grouping is that which fits the case of *portable* motors, though it might not, in American practice, fit the case of *stationary* motors. For stationary motors at constant *load* and constant *speed*, Mr. Snell doubtless finds that he must vary the proportions of field and armature in the direction of Mr. Mordey's limit. As the load or the speed become, either, or both of them, variable, he has to come nearer and nearer to the middle points, probably more so than in American practice, however, for the reason that weight would be classed here among the considerations of lesser importance, as a rule, while efficiency would likely be put among those of greater importance, somewhat contrary to Mr. Snell's scale of relative importance.

Now passing on to portable motors for traction, hoists, etc., the proportions would gradually approach the point set by Mr. Tesla, and if the speed and load varied within

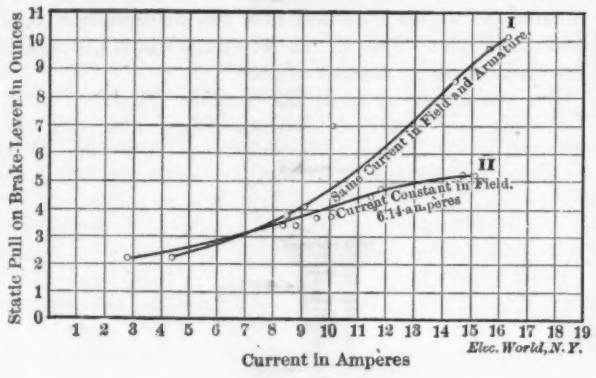


Fig. 1.

wider limits still, *this point would even be passed*, and the proportions would approach the point set by Profs. Ayrton and Perry. During this transition, the design would undergo considerable changes in proportion, and would experience a corresponding change in quality by graduations. We would find that we had gained in certain qualities and lost in others. If we could properly and fully estimate the value of all advantages and disadvantages, we would probably find that the net aggregate sum was nearly constant, within wide changes of proportions. So that the whole effect of successful designing lies in the art of knowing or finding out which qualities to emphasize and which to sacrifice, in order to obtain maximum results under given conditions.

Returning now more particularly to the question of the ratio between magnetic moments in field and armature, the principle formulated by Mr. Tesla is in reality a statement of the fact that when *torque* is the great desideratum, or the quality to be emphasized, even at the expense of certain considerations (perhaps including efficiency), but without sacrificing lightness, then the "maximum" is reached when the magnetic moments are made equal in field and armature. Mr. A. T. Snell, in the paper just noted, lays great stress on the torque as being, so to speak, the "natural" starting point in motor design. Hence it is presumable, and his practice indicates, that he must be fully aware of the conditions under which the maximum obtains. The first one, however, who seems to have grasped and applied this principle of maximum torque is, so far as the writer is aware, Mr. Anthony Reckenzaun, in England, who seems to have started from the Ayrton and Perry "limit," and worked back to the "middle" point. For several years Mr. Reckenzaun has designed his traction

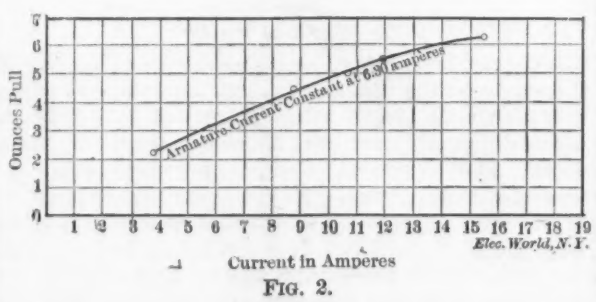


Fig. 2.

motors substantially on these lines. I have already expressed the opinion that such a design appears well suited to portable motors. Personal experience leads me to believe that it is also well suited to the purposes of street-car traction.

Dr. O. Froelich has also put the question quite clearly in his work on "The Dynamo-Electric Machine" (1886). The following is a liberal translation from a paragraph entitled: "On the proportion of the respective windings of the field and armature."

"In seeking the best possible winding for an armature, one is faced by two problems of almost contrary natures, viz.: the *electrical capacity* required of the machine, and the *proper working of the commutator*. If it were merely a question of obtaining for a given weight and speed the greatest possible capacity, one could scarcely increase too much the space allowed for the armature winding and the weight of wire. But the designer soon observes that as he puts on more wire the sparking of the commutator and the wearing away of both commutator and brushes increase. Now, since the deterioration is of foremost importance from the practical point of view, the designer is forced to restrict the amount of wire on the armature to the limit imposed by this circumstance.

"It is almost impossible to set, in a general way, a minimum value to this amount of wire; all depends in that regard on the special qualities of the type of machine under consideration. Experience alone can furnish exact data on the subject, and exhaustive researches alone can guide the designer in this path and determine the amount of wire suitable for the machine which he is constructing."

Some two years ago, having to design some motors for street-car traction purposes, to be used, as is now the general rule, with a *constant* gearing ratio, the *torque* required at different speeds and under different conditions was made the starting point of calculation, precisely as since recommended by Mr. Snell in his paper. Reasoning from simple cases, such as conductors or magnets reacting upon each other, the conclusion was soon reached that the torque would depend upon the combined effort of both field and armature magnetism. When opportunity presented, the experimental demonstration was made. The accompanying curves show the result of the experiments, which were made with considerable care with a small series motor. The following extract, taken *literatim et verbatim* from my note book, explains these curves, and also gives some idea of my method of reasoning at the time.

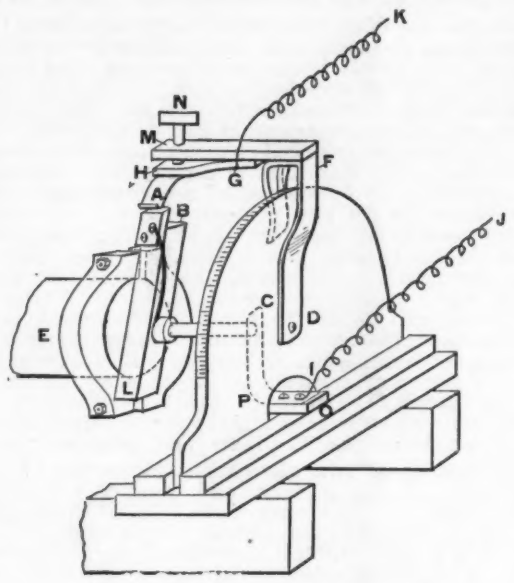
"March 23, 1888.—I made an experiment yesterday with a small 'C. & C.' motor, to test the influence of the ampère-turns of the field and armature *on the torque*. The current was first passed through both field and armature curve *I*, Fig. 1, in the ordinary way, and the pull on the lever noted for different currents. Then the current was made constant in the field and varied in the armature, curve *II*, Fig. 1, and also, *vice versa*, Fig. 2. From the data the curves made show that the torque increases with the current in *both*, as reasoning would lead one to expect. I tried the experiment on purpose to satisfy myself regarding the advantage of increasing the number of *turns on the armature*, contrary to the accepted doctrine that a good dynamo is a good motor, for it is well-known that, in dynamos, practice is drifting in the direction of putting only a few turns on the armature, and strong field coils. I reasoned that in a motor that is to give maximum torque, this would be wrong. The motion, or tendency thereto, is the result of the field's distortion, by the deflecting power of the armature coils, whose tendency is to make poles at the neutral point, or in a line of polarity at right angles to that which the magnetic field of the field coils produces. *I look upon the phenomenon* as one *where the armature forcibly pulls the field of the field magnets out of their axial line, leaving them* (lines of force) *to rebound* or spring *by causing motion of the armature*. Consequently the moment exerted depends not only on the power of the field magnet but on that of the armature. . . ." The sentence which is here italicized is merely a passing reference to my views regarding the nature of the reactions taking place in an electric motor, which I conceive to be a process whereby energy (electro-kinetic) is abstracted from the electrical circuit to forcibly displace lines of magnetic force temporarily, the energy thereby stored in the form of elastic tension being conveyed or transmitted immediately after to the moving part of the motor, as the lines of force fall back to their original stations by virtue of this tension.

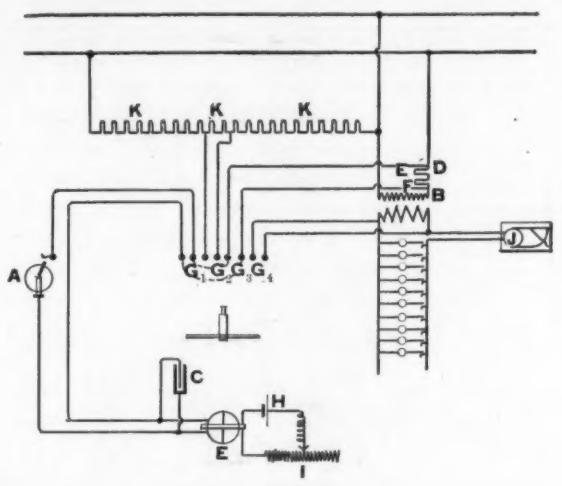
These curves made it clear first, that the torque can be increased just as well by increasing the armature ampère-turns as by those of the field magnet, the two methods giving very nearly the same results. Second, that the best result would be obtained by increasing the magnetic powers of both field and armature equally.

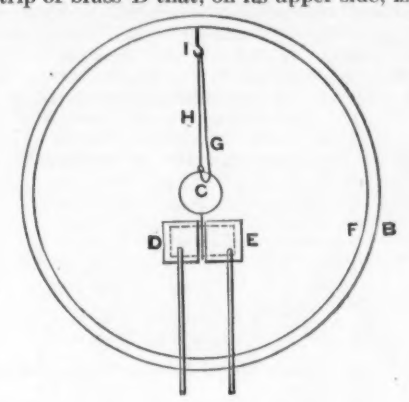
The design was, therefore, made with the object, among others, of giving to the field and armature, as nearly as possible, equal moments when connected for *starting;* or, on the first step of the regulator. The armature was in reality somewhat in excess, the ratio being 1 to 1.08. This design was considered as somewhat radical, and, I have reason to believe, was regarded in some quarters as indicative of more or less empiricism or ignorance of "orthodoxy" on the designer's part. It is true that the motor could make a given car travel more miles with a given amount of energy in watt hours than the orthodox motors. But it was thought to be all wrong somehow and anyhow. On reading the interesting and able article by Dr. Louis Bell in the Dec. 14 issue of this journal, I now conclude that it *must* have been wrong—it was apparently some two years ahead of its time. We shall probably continue for some time to come to run street cars with motors that are really better suited for stationary work. It will take some time to educate ourselves to the full recognition of the fact that the greater portion of the energy is consumed in making starts, and that a motor having a somewhat low "all-round" efficiency, and where you *want it*, is of greater value than one having a very high efficiency at one point available after the car is well under way.

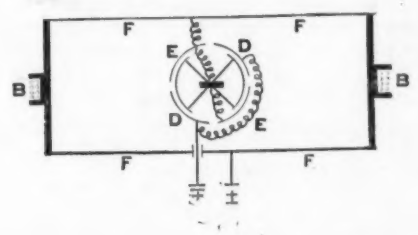
It would seem that, strictly speaking, the condition for maximum torque is not, in practice, that the ampère-turns of field must exactly equal those of the armature, as Mr. Tesla asserts. This appears to be a direct consequence of the fact that the magnetic field in a motor is in reality somewhat stronger than what would be accounted for by

the effect of the field coils alone, showing that the magnetic induction is a resultant of some sort, including the magnetizing power of the armature as one of its components. The nature of the reaction which takes place between the armature and field magnet forces is still much of a mystery. It may be that, instead of an increase in the magnetizing power, there is a diminution in magnetic resistance by the change of distribution brought about in the magnetic field by the influence of the armature ampère-turns. At any rate the effect is in many respects the same as if a certain number of turns had been added to the field coils; the contrary being the case in a generator, where the effect is as if a certain number of turns had been neutralized in their action. It is exactly owing to want of light on this mystery that no satisfactory or complete formula has yet been found by means of which the torque can be calculated before construction with certainty and precision for all values of the current in a series motor. This interesting part of the subject cannot be discussed here, but may form the subject of a subsequent article.









FIGS. 1, 2 AND 3.—TESTS UPON TRANSFORMERS.

Transformers.*

BY HARRIS J. RYAN.

The apparatus by means of which electrical energy of one form may be transformed to that of any other form few engineers fail to appreciate. So great have been the anticipated possibilities offered by the application of the modern transformer of alternate current energy, that in most cases, in our country especially, the transformer has found immediate application, with but little thought or study of its exact performance. Much experimental work has been done by trial methods to the end that our manufacturers are able to supply transformers that answer for much that is desired practically, with a commercial efficiency that can be made higher than is probably possible by any other transformer of energy.

In electrical engineering, as well as in other branches of engineering for the broad application of one method or another, it is always of the highest importance that the cause and extent of every effect be thoroughly understood with regard to the mutual action and interaction of all forces and materials in relation to themselves, or to energy of one form or another.

It was with a view of obtaining so far as possible a clear understanding of all phenomena that take place in the commercial transformer, that the work producing the results here set forth was undertaken. It has not been possible at this time to prepare a paper as complete as has been desired and we trust that in the near future we may add more data to that which is here presented.

* A paper read before the American Institute of Electrical Engineers, New York, Dec. 17, 1889.

At the outset it should be said that the results of the experiments that are here presented were wrought out jointly by Mr. Ernest Merritt, of the Department of Physics, Cornell University, and the writer. What we had in mind in the work was an accurate determination of the exact performance of the commercial transformer whereby one should be able to derive results and data that should enable all phases of the performances of transformers to be understood clearly, and that should show the requisite principle of proper design.

It may be well to state briefly the general method we employed. A single ten-light transformer that had been made and supplied for commercial purposes for incandescent lighting with 1,000 volts in the primary and 50 volts in the secondary was selected as a sample for investigation. It probably represented fairly well the average commercial performance of transformers, and might therefore be said to embody, to a certain extent at least, proportions that have proven by experience and experiment to be best for the particular purpose for which it is supplied.

This transformer was operated under the same impressed E. M. F. supplied from the electric lighting plant in which it had been used for supplying incandescent lamps commercially. It was operated with its secondary open and the same closed through one lamp, five lamps, and ten lamps, and under these several conditions the exact instantaneous values of the ever varying, primary impressed E. M. F., primary current, and the E. M. F. at the terminals of the secondary, were observed. Again, under these several conditions the square roots of the mean squares of the above values and of the secondary current were also observed. Then with these observations, the dimensions, and the details of the construction of the transformer, many of the facts and performances that the engineer is concerned with are brought to light.

Naturally the first thing to be considered is the electrical measurements and how they were made. A point on the armature of an alternator always passes a fixed point in its circumference at a time corresponding to a definite value of the varying E. M. F. and current, alike, with regard to these quantities in the primary feeders, transformer, primary or secondary, etc., so long as the conditions remain constant. In our experiments, we were only concerned with the values of the E. M. F. impressed at the terminals of the primary, the primary current and the secondary E. M. F.; then, by changing the position of the fixed point relative to the machine, the rotating point of reference in the armature would pass the new position of the fixed point at correspondingly different values for the primary E. M. F., primary current, and secondary E. M. F., with respect to themselves and the position of the armature.

In Fig. 1, *B L* is a prism of hard rubber bearing a projecting strip of brass *B* that, on its upper side, is filed to a dull edge. This edge is taken as a fixed point on the armature. An arm *F D* is arranged to rotate about *D* as a centre, a point that is in line with the axis of rotation of the armature. A semicircular board of hard wood, attached rigidly to the dynamo frame, serves both as a support for this arm and a circumferential scale whereby the position of the arm may be observed relatively to the machine. The arm is made of brass, and given the form shown in the figure. It was bent into a U-shape at the top so as to pinch the board, and thus remain fixed in any position desired. At the top of this arm is mounted a bar of hard rubber projecting toward the dynamo parallel to the armature axis. On its under side, fastened at *G*, is a brass strip; a tongue *H A* of spring brass is attached at the end, and at right angles to the brass strip *H G*, as shown. The position of this part of the apparatus is carefully adjusted so that the point about which the arm rotates is in line with the axis of rotation of the armature, and the sharply upward curved end of the tongue *H A* just over the edge of the brass strip at *B*. Then when the armature is rotated the strip *H G* may be sprung inward radially by turning the thumb screw *N* until the tip of the tongue *A* is heard to just lightly touch the edge at *B* as it passes. The arm may then be adjusted by hand so that the tongue will touch the fixed edge on the armature at any desired phase of the primary E. M. F., primary current, or secondary E. M. F. and current. Coaxially with the armature a small brass rod is mounted on the bar of hard rubber *B L*. It is connected metallically to *B* by means of a wire. At *O*, on the frame work supporting the semi-circular board, etc., is mounted another piece of hard rubber,

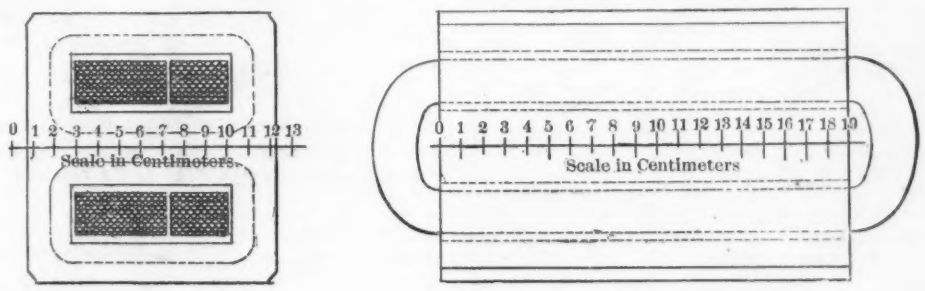
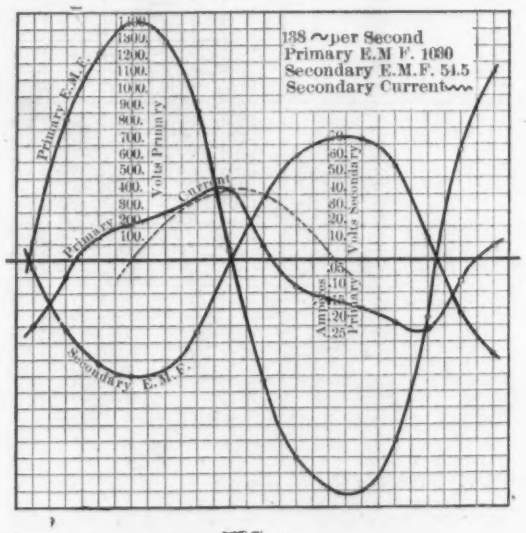
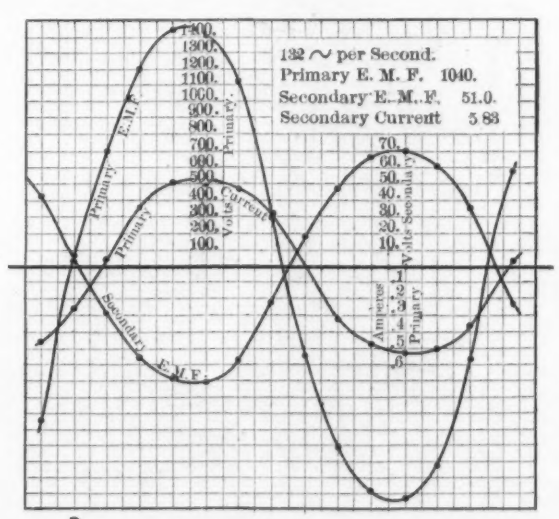
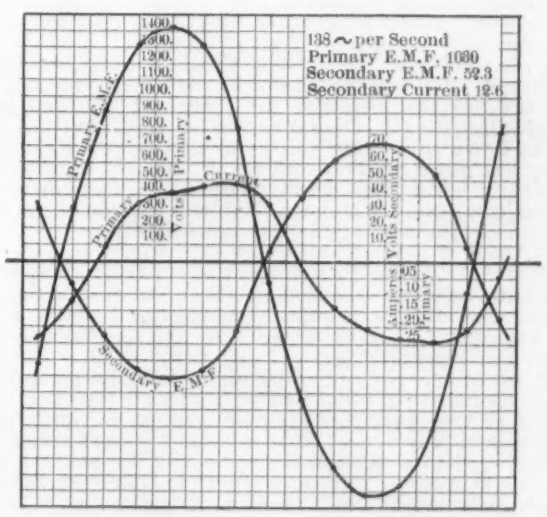


FIG. 4.—TESTS UPON TRANSFORMERS.







FIGS. 5, 6 AND 7.—TESTS UPON TRANSFORMERS.

insulating and supporting the thin metallic strip *P C* that bears against the above brass rod. *G* and *I* then are the terminals of this commutating apparatus.

In Fig. 2, *E F* is a non-inductive resistance in series with the primary of the transformer which is at work. At *A* is the apparatus described in Fig. 1, and *E* is an electrometer, reading through a wide range.

The terminals of the above non-inductive resistance and those of the electrometer are connected together through the commutating apparatus at *A*. Then it must be evident that the electrometer will become charged with a difference of potential equal to that existing between the terminals of the non-inductive resistance at the instant that the fixed edge on the armature passes the tip of the tongue in the apparatus at *A*. By reading the indications of the electrometer, therefore, and knowing the value of the non-inductive resistance *E F*, the value of the primary current corresponding to the particular phase due to the position of the arm in the apparatus at *A* becomes known. In a similar manner the primary and secondary E. M. F. are observed by changing the connections accordingly at G_1, G_2, G_3, G_4. Then the arm is rotated to another position, corresponding to a different phase, and the corresponding values of E. M. F. and current again observed as before. In this manner we proceed at equal intervals, sufficiently near, so that a curve may be determined by the values thus observed at the several intervals, so that the values of the E. M. F.'s, or currents, shall be accurately known at all times throughout a complete period.

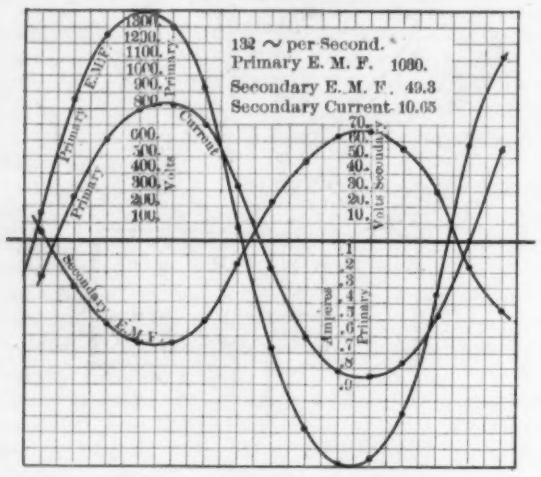
A few words with regard to the electrometer at *E* are not out of place here. It is the form that the writer devised especially for this and similar purposes. The essential features for an electrometer for these purposes are that it shall have the widest possible range through which it will read with accuracy. Its indications must be unvaried by the absolute potential to which it is subjected as a whole. Its law must be perfectly definite, and it is also desirable that its constant be unchanging.

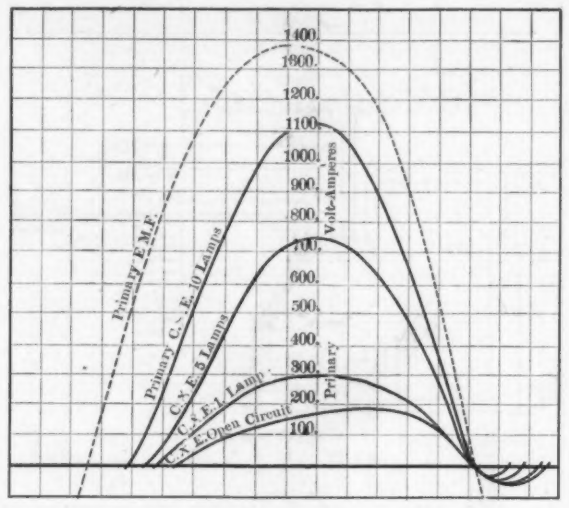
Fig. 3 illustrates this instrument in diagram. It consists essentially of cylindrical electrometer needle and quadrants *E D*. To the upper side of the electrometer needle is attached a magnetized steel mirror that acts as a magnet and as a mirror for observing the position of the same. The needle is hung by a single silk fibre *H*, from a hook in the top of the case, as shown. Metallic contact from the needle to the case is made by means of a platinum wire .0002 inch in diameter. This wire is readily provided in the desired form by using the platinum-cored silver wire that is supplied by makers of surveying apparatus. It is cut to the desired length, and hooks bent into shape at its terminals. By immersing all of it but the hooked terminals in nitric acid, the silver is dissolved away, leaving the fine platinum core terminated by the two silver hooks. One end of this platinum wire thus prepared is linked into a hook into the top of the electrometer case, and the other end into a small ring formed by a twist of the aluminum wire that surrounds the mirror *C*. The electrometer case is circular, and the above needle and quadrants are arranged so that the magnetized mirror is at the centre of the case and the needle and quadrants below it.

About the case, as the figure indicates, is wound a coil *B B* of rather fine insulated copper wire. The magnetized mirror and thin coil then, when the latter is in the magnetic meridian, constitute an arrangement similar to that of a tangent galvanometer. In the electrometer, the needle, case, and one set of quadrants are connected together and form one terminal, and the other set of quadrants, being connected together, form the other terminal of the instrument, in the manner set forth in the diagram. Thus, then, when the electrometer terminals are subjected to a difference of potential, the needle is acted upon by a couple brought about by the electrostatic forces, and is deflected from its position of equilibrium. Then, as is shown in Fig. 2, current from a gravity cell in circuit with a suitable rheostat is sent through the coil on the electrometer in such a direction that the needle is brought toward its zero position by the action of the coil carrying the current, on the magnetized mirror. The current is then further adjusted till the needle stands balanced at zero under the mutual action of the electrostatic and the electromagnetic forces. Under such circumstances, then, the difference of potential is proportional to the square root of the current.

If we can, as was the case when the measurements here presented were made, consider the E. M. F. of our cell constant, the difference of potential is likewise proportional to the square root of the reciprocal of the total resistance in circuit with the cell. Parallel readings, taken with a standard voltmeter throughout a range varying from 3 to 600 volts, gave identical results, showing no deviation from the above law, and an unvarying constant. On account of the metallic case and its connection to the rest of the apparatus, the indications of the electrometer are, so far as could be observed, entirely independent of the absolute potential to which it is subjected as a whole. In Fig. 2, when contact was made at *A*, and the electrometer charged to the potential difference to which its terminals were then subjected, it was found that considerable of the charge was dissipated by leakage during the course of a revolution of the armature, no matter how good the insulation of the apparatus was. A one-half microfarad mica condenser was then placed in multiple arc with the terminals of the electrometer at *C*. Then, after a few revolutions of the armature, the condenser became charged to precisely the same difference of potential existing at the terminals of the electrometer *D B*, as shown in Fig. 2, when the rotating edge on the armature passed the tip of the tongue on the arm at *A*.

Under these circumstances the leakage that occurred was entirely unobservable as compared with the charge in the condenser during the course of time required for the armature to make many revolutions. Thus arranged then, the electrometer would give accurate readings of the primary and secondary E. M. F.s' and primary current corresponding to the connection of the terminals and the position of the arm *A*. Again the square root of the mean square of any of these values could at any time be read from the electrometer by short-circuiting the apparatus at *A*, and cutting out the condenser at *C*. For the purpose of obtaining the curve of impresssed E. M. F. and the $\sqrt{\text{mean}^2}$ of the same, twenty-two 50-volt lamps were put in series across the primary circuit. The $\sqrt{\text{mean}^2}$ of the impressed E. M. F. in the primary was then obtained by reading by means of the electrometer with the condenser cut out and the commutating apparatus short circuited, the $\sqrt{\text{mean}^2}$ difference of potential existing between each set of two lamps. In this way eleven readings were obtained, the sum of which was the total impressed E. M. F. This served as a calibration of the non-inductive resistance formed by the lamps. At the same time that these observations were made, two lamps were determined upon to be used in all subsequent observations on the total E. M. F





FIGS. 8 AND 9.—TESTS UPON TRANSFORMERS.

In series with the secondary circuit was placed a gravity ammeter containing a few small turns, and correct in its adjustment. It indicated the $\sqrt{\text{mean}^2}$ in the same way that an electro dynamometer would have done. The observing of the various values of the secondary E. M. F. required no special arrangement; this was done direct in all cases. Since the secondary was always at work on a circuit possessing almost no inductance, no determinations of the curve of secondary currents were made, for it would be found to be so nearly in unison with the secondary E. M. F., and possess all the characteristic variations of the same. The $\sqrt{\text{mean}^2}$ of its value was always known from the indications of the ammeter. As a load for the transformer, ten 16 c. p. 50-volt lamps were provided that could be turned on and off as desired, and they were at an average distance from the transformers of not more than five feet.

G_1, G_2, G_3, G_4, represent, in Fig. 2, the various terminals conveniently arranged on a switch board for ready adjustment for any desired set of connections. The adjustable resistance at *I* consisted of a plug resistance box enabling one to get any number of ohms in circuit from 100,000 down. It was very conveniently arranged; but a suitable slide rheostat and a damped magnet on the electrometer needle would have facilitated greatly the rapidity with which observations could be taken. The mode of procedure was to set the brush at some suitable point of starting out; then, corresponding to this point, readings of the instantaneous values of the primary E. M. F. were made. When lamps were turned on in the secondary, the ammeter in that circuit was also read. The brush was then moved forward to a new position and the above readings repeated. This was continued until we had gone over a complete period of two alternations; then the $\sqrt{\text{mean}^2}$ readings of the primary and secondary E. M. F.'s and primary current were made. To do this required a period of time covering usually not more than two and one-half hours. Careful observations were made which showed that the insertion of one, two or three lamps in the primary circuit *did not perceptibly change the relation* of the primary E. M. F. and current and secondary E. M. F. The indications of the ammeter gave data for correcting for variations of the speed of the dynamo which, throughout, were not great.

The following data should be given with regard to the transformer that was used by us:

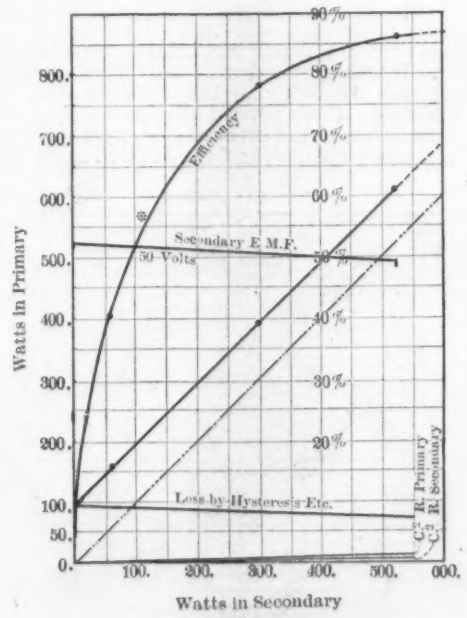
No. of turns in the primary circuit coil	675
No. of turns in the secondary coil	35
Resistance of the primary	21.8 ohms
Resistance of the secondary	.04 ohms

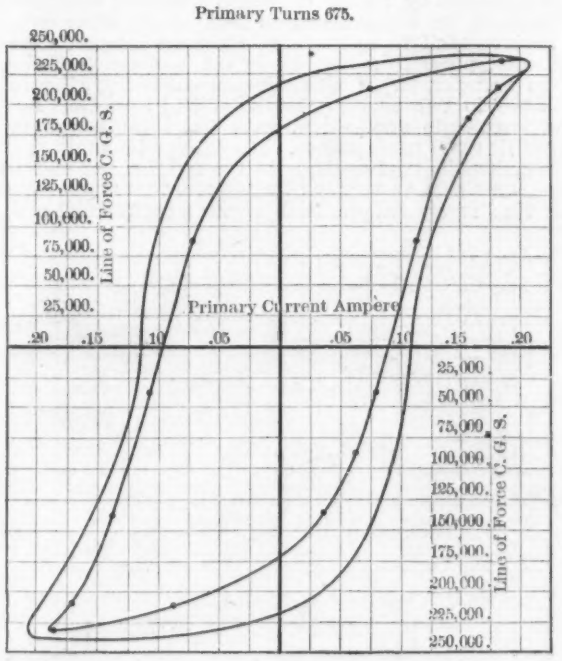
Fig. 4 is furnished with a scale, to which it was drawn, so that from it any details as to dimensions of the transformer can be obtained.

The iron discs of the magnetic circuit of the transformer were made ½ millimeter in thickness, and its surface merely oxidized so that no special insulating material was provided between the laminations. The total volume of laminated iron used in the transformer was 2,050 cubic centimetres.

The mean cross section of the magnetic circuit was 63.3 square centimetres, and the mean length of the magnetic circuit 30.8 centimetres.

The following observations with the secondary on open circuit, and working on one lamp, five lamps and ten lamps, were made and have been plotted in Figs. 5, 6, 7 and 8; the corresponding curves located by them were drawn in by the scales designated:





FIGS. 10 AND 11.—TESTS UPON TRANSFORMERS.

The above observations served, then, as a calibration for the indications of the two lamps thus to be used. For the constant obtained by the ratio of the above total E. M. F.. to the E. M. F. of these lamps taken at the same time, always served to deduce the total $\sqrt{\text{mean}^2}$, or any particular value corresponding to a particular phase of the impressed primary E. M. F. when the same had been observed with regard to the two lamps in the group thus set apart. In this way we avoided the direct measurements of the total impressed E. M. F.

Two 50-volt lamps *E* and *F* were placed in series with the primary as a non-inductive resistance, and, as previously stated, the $\sqrt{\text{mean}^2}$, and the values corresponding to any particular phase of the fall of potential through these lamps, were observed. This gave a measure of the $\sqrt{\text{mean}^2}$, or any particular value corresponding to a particular phase of the primary current, when the resistance of these lamps was known at the temperature to which they were brought by the current. A curve of resistances corresponding to the range of currents through which we used these lamps was determined carefully by Mr. Merritt at the Cornell Magnetic Observatory.

Secondary on Open Circuit. See Fig. 5.

Brush Reading.	Primary E. M. F.	Current.	Secondary E. M. F.
21	119	.20	5.5
20	855	.05	62.7
19	1.250	.07	63.4
18	1,420	.11	70.7
17	1,330	.14	66.8
16	900	.19	46.0
15	45	.21	00.0
14	751	.04	37.8
13	1,210	.08	62.0
12	1,390	.12	72.0
11	1,410	.15	72.5
10	1,100	.18	57.8
9	355	.21	14.5
8	645	.08	32.3
7	1,130	.04	57.8
Observed $\sqrt{\text{mean}^2}$	1,025	.14	54.5
Calculated from curves $\sqrt{\text{mean}^2}$	1,030	.147	53.5

SECONDARY CLOSED THROUGH ONE LAMP. SEE FIG. 6.

Brush Reading.	Primary E. M. F.	Current.	Secondary E. M. F.
28	605	.225	31.4
27	330	.125	15.3
26	917	.048	45.2
25	1,300	.179	67.6
24	1,403	.215	71.7
23	1,300	.235	67.1
22	820	.239	43.8
21	132	.185	4.7
20	835	.000	3.9
19	1,238	.151	61.5
18	1,420	.215	71.7
17	1,363	.238	68.4
16	1.026	.246	52.7
15	170	.215	9.7
14	793	.048	35.6
Observed $\sqrt{\text{mean}^2}$	1,053	.196	52.3
Calculated from curves $\sqrt{\text{mean}^2}$	1,021	.190	514

Mean of ammeter reading, 1.26

SECONDARY CLOSED THROUGH FIVE LAMPS. SEE FIG. 7.

Brush Reading.	Primary E. M. F.	Current.	Secondary E. M. F.
29	956	.449	40.3
28	41	.250	10.4
27	723	.000	28 9
26	1,194	.356	54.8
25	1,447	.495	69.1
24	1,350	.483	67.2
23	1,103	.453	57.6
22	293	.304	21.5
21	560	.000	19.8
20	1,110	.318	48.8
19	1,383	.464	65.7
18	1,429	.511	70.0
17	1,228	.500	60.3
16	567	.374	24.0
14.7	585	.030	23.4
Observed $\sqrt{\text{mean}^2}$	1,050	.390	51.0
Calculated from curves $\sqrt{\text{mean}^2}$	1,036	.383	50.6

Mean ammeter reading, 5.83

SECONDARY CLOSED THROUGH TEN LAMPS. SEE FIG. 8.

Brush Reading.	Primary E. M. F.	Current.	Secondary E. M. F.
21	138	.242	5.2
20	826	.276	29.7
19	1,237	.642	53.5
18	1,378	.795	64.0
17	1,300	.821	64.3
16	924	.700	51.1
15	63	.340	1.50
14	698	.188	23.7
13	1,138	.587	49.0
12	1,370	.810	63.7
11	1,343	.844	66.0
10	1,073	.771	26.5
9	323	.479	26.5
8	590	.000	17.0
7	1,117	.538	42.8
Observed $\sqrt{\text{mean}^2}$	1,040	.631	49.3
Calculated from curves $\sqrt{\text{mean}^2}$	1,020	634	49.3

Mean ammeter reading, 10.65.

In Fig. 9 are plotted curves deduced from the foregoing observations that show clearly the rate at which energy is given to the transformer, or that which the transformer restores to the circuit at all points of a complete alternation for the several conditions under which the transformer was operated. The curves themselves show so clearly this particular part of the performance of the transformer that nothing more need be said about them, except to give the percentages of the work given to the transformer that is restored to the circuit by it under the several foregoing conditions:

Open circuit, 6.8 per cent.
One lamp, 3.9 per cent.
Five lamps, .96 per cent.
Ten lamps, .36 per cent.

The above observations and data are ample wherewith to compute the various losses of energy that take place in the transformer under the several loads and under no load, and the deduction of the corresponding efficiencies. These values have been computed, and are given in the following table.

Proper corrections have been applied for the two lamps in series with the primary of the transformer.

	Secondary E. M. F.* Primary 1020.	Primary watts.	Secondary watts.	Efficiency.	Total loss in watts.	Hysteresis loss in watts.	Heating loss. Primary watts.	Heating loss. Secondary watts.
Secondary open.	5.23	96.1	0.0	0.0	96.1	95.7	0.4	0.0
One lamp.....	52.3	159.1	64.3	41.1%	94.8	93.9	0.9	0.0
Five lamps.....	50.1	388.6	300.9	77.5%	87.7	83 1	3.3	1.3
Ten lamps.....	47.5	607.9	525.0	86.6%	82.9	69.7	8.7	4.5

*The values given in this column have not been corrected, for the two lamps in series with the primary for the first three conditions and the one lamp that was used for the last. With ten lamps, where one lamp was used in the primary this correction amounts to an increase of the secondary E. M. F. of 3 per cent. On open circuit and with one lamp it is negligible, and 3 per cent. increase for five lamps. When this correction is applied the drop of 3.5 volts obtained is what was observed by direct measurement on the secondary.

In Fig. 10 these values have been plotted to scales there indicated and the respective curves that they determine have been drawn so that one can plainly see the exact performance of the transformer under all loads.

It is interesting to note that this transformer might be loaded to twice its rated capacity, and the heating of the coils would still be less than that of the iron, although the heat produced by the iron grows less as the load comes on. Likewise, that its efficiency would not yet have reached its maximum, and that it would have a value of 92 per cent. In Fig. 11 the outer curve represents the relation between the magnetizing current in the primary and the degree of magnetization for all points of a complete cycle. The values locating the curve expressing this relation were readily deduced from the observations made when the transformer was working on open circuit. In Fig. 5 the dotted curve represents the curve of primary current that would be found, should Foucault currents be known to be absent, and the relation or ampère turns and magnetization be the same going up, as coming down. Then if Foucault currents were present the dotted curve would have a component at a quarter of a period in advance. This would produce a negative lag in the dotted curve. From the position of the actual primary current it is plainly seen that but a very small component of the above nature is possible, and that the energy that is wasted by eddy currents must therefore be small. The radical departure of the primary exciting current from the approximate sinuous variation of the primary impressed E. M. F. is plainly brought out to be due to *hysteresis*. From the preceding consideration it is also evident that almost the entire advance of the exciting current, and therefore the corresponding dissipation of energy, is due to the same cause.

It was thought of much interest to see what amount of hysteresis should be indicated by carrying the transformer *slowly* through the same cycle of magnetization that it went at the rate of 138 cycles per second when at work on the circuit with its secondary open. Accordingly by Ewing's method, modified for the purpose by Dr. Sumpner, Mr. Merritt determined the inner curve shown in Fig. 11. We regret greatly not to have had time for a careful redetermination of this inner curve, and to carry the magnetization to the same maxima that was done in the transformer when on the circuit. The agreement between the cards would have been more marked even than in Fig. 11.

The assumption made by Mr. Swinburne in his remarkable and valuable paper on the "Design of Transformers" (Proceedings of the British Association, 1889), would therefore be fully substantiated. Mr. Mordey's experiments, in which *hysteresis* and *Foucault current* losses producing a common loss were determined, were performed by cycles of magnetization produced by rotation, in which the degree of magnetization did not vary in amount, but in direction, and cannot be said to throw light on the correctness of Mr. Swinburne's assumption. Some, commenting on this paper, have used Mr. Mordey's results as evidence that these assumptions are wrong.

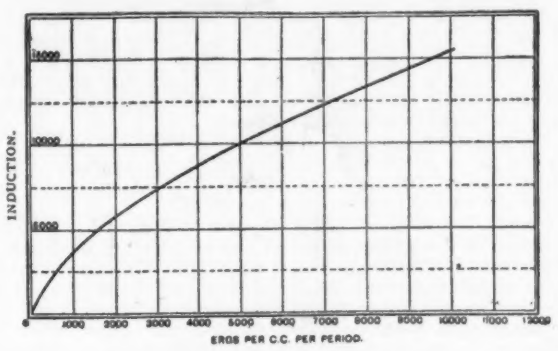


FIG. 1.

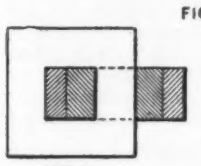


FIG. 2.

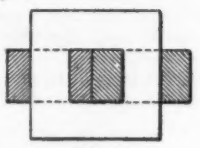


FIG. 3.

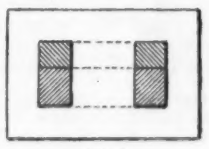


FIG. 4.

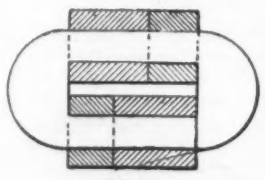


FIG. 5.

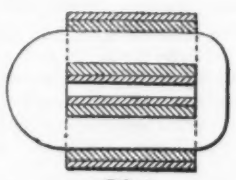


FIG. 6.

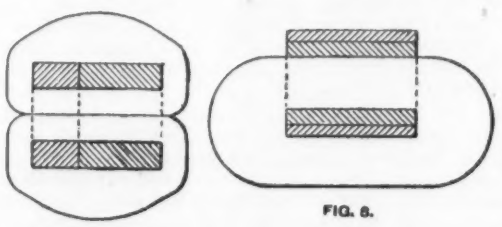


FIG. 8.

CONSTRUCTION OF TRANSFORMERS.

By a knowledge then of the magnetic properties of the iron with which a given transformer is to be built, and the methods made use of by Mr. Swinburne, its efficiency is something that can be correctly predetermined.

The importance of making a transformer produce the same E. M. F. at the terminals of the secondary under all loads asserts itself when it is used for incandescent lighting. In the transformer under consideration, from the ratios of the primary and secondary turns, the E. M. F's. that they produced, and the variations of magnetization that had to take place through the primary in order that the same should produce an E. M. F. equal and opposite to that of the primary-impressed E. M. F., the magnetization produced through the secondary, and the magnetization set up about the primary in its own air space are determined. In the present transformer this "leakage" of magnetism amounted to about 1.2 per cent. When the transformer works on full load 4.5 times as much current passes through the primary, and the "leakage" of the primary in its own space is 4.5 times as much as an open circuit, and becomes 5.4 per cent. This value, together with the small drop due to the actual resistances of the transformer coils, accounts for the fall of 3.5 volts that was observed by turning on all of the ten lamps.

Attention might be called to a similar "leakage" in magnetism that takes place in the secondary circuit. It is plainly brought out in Fig. 8, by the lag of the secondary E. M. F. The magnetic "leakage" producing a self-induction is proportional to the secondary current. The rate of change of this quantity, then, is proportional to the E.M.F. that it produces. This E. M. F. is therefore a quarter of a period behind the secondary current and results in producing a small lag in primary and secondary currents and secondary E. M. F.

Finally, there is a curious behavior of this transformer that remains to be accounted for. This is the considerable decrease in the loss by hysteresis, as the transformer is loaded down; that is not to be accounted for by rise of temperature or the falling off of the magnetization due to the increased "leakage" about the primary in its own air space. The following reason suggested itself to the writer why this should take place:

Mechanical shock has been shown to greatly reduce loss by hysteresis when iron is passed through cycles of magnetization. Since the currents are at all times opposite each other in the two coils of a transformer, strong repulsion occurs when these currents are at a maximum and no force is exerted when they pass through zero. So it follows that they continually keep thrusting each other apart when at work, and add to the disturbance of the laminated iron that already exists on account of its changing magnetization. This increasing of the mechanical vibration of the iron may therefore account for the above mentioned phenomenon.

On open circuit the maximum magnetization of the iron per square centimetre was 3,850 C. G. S. units.

Loss by hysteresis per cycle per cubic centimetre, neglecting Foucault currents, .046 watts at 138 reversals per second.

Coercive force per centimetre of the iron, 2.76 C. G. S. units.

In conclusion the writer would say that the data here given show for themselves so clearly the advisability of providing some practical means for breaking the primary circuit of the transformer when not in use, that the strong advice of Mr. Swinburne in concluding his paper need not be repeated.

The Design of Commercial Transformers.

BY J. SWINBURNE.

II.

In each period the whole of the induction in the core cuts the coils four times. The electromotive force is therefore

$$E = 4ABTN \times 10^{-8},$$

where A is the cross sectional area of the core in square centimetres, B is the effective induction in c. g. s. units, T is the number of turns in the coils, and N is the frequency. This gives the value of E in volts. This formula really gives the back electromotive force on the primary circuit, or the internal electromotive force of the secondary; but, as already mentioned, we may take these instead of the terminal electromotive forces, at any rate in this part of the calculations.

In designing a transformer we have thus merely to select values of A and B, that is to say, we have to choose the section of the core, and the induction. If the induction is taken very low, the result is that a great deal of iron must be used for a given number of turns of wire. If the cross section is great with a given number of turns of wire, each turn of wire must be longer, and this means loss of power in the copper. Moreover, the extra iron is expensive, and so is the extra copper. On the other hand, if the iron is taken up to a high induction there is great loss of power in the reversal of magnetization. At high inductions the permeability of the iron also is less, so that the magnetizing current is increased, but in closed circuit transformers the question of heating is infinitely more important.

Though the heating of the iron due to reversal of magnetization is of the utmost importance, there are, unfortunately, no data available which give the loss under actual conditions. The only figures which give us anything to go upon are in Professor Ewing's paper on the magnetization of iron. He took a long thin wire of soft iron, and magnetized it slightly in one direction, then to the same degree in the other direction, and then demagnetized it and measured the energy absorbed in the process. He then magnetized the wire more strongly, and repeated the experiment, and so on, getting the loss of energy for each complete reversal. The results are plotted in the accompanying curve, Fig. 1. The ordinates give the induction, the abscissæ give the loss per cubic centimetre of iron per cycle in ergs. These experiments were done slowly, and it does not follow that if a certain quantity of energy is wasted when the iron is carried round the circle slowly, no more energy will be taken when the reversal is performed quickly. The figures given by Professor Ewing for slow reversals are fairly close to those absorbed in direct current dynamo practice, so it is unlikely that they are far out for transformer work, where the frequency is four times as great. Of course the loss now under discussion has nothing to do with the loss by Foucault currents. The loss from this cause varies as the square of the frequency, and can be made as strong as desired by laminating the iron enough. For want of a better one we may, therefore, assume that the curve plotted from the experiments on slow reversals is right. It will be noticed that the loss per cubic centimetre throughout most of the range is a straight line, which does not pass through the origin.

If the induction is increased the loss in the iron is increased somewhat more rapidly; so that with a given number of turns, if the core is decreased and the induction increased to make up for it, the total waste of power in the core is greater, unless the alteration in dimensions reduces the volume of the iron more quickly than in proportion to the cross section.

The design of a transformer is like most other designs, a sort of compromise. What is wanted is the highest efefficiency combined with the lowest cost of manufacture and the greatest durability. The last requirement means that the transformer must be of a shape that admits of perfect insulation, and it must be well enough ventilated not to get hot.

In practice nearly all makers use punchings of thin, soft iron, and the punchings to a certain extent determine the dimensions of the transformers, for it would be too expensive to make a different set of punches for every type of apparatus made. The punches are designed so that the coils can be wound separately, and the punchings then slipped over them; but, though they differ in the ways in which this is allowed for, they may all be divided into two or three classes. When put together they either make punchings with a rectangular hole for the coils, the coils returning on one side, as in Fig. 2, or on two sides, as in Fig 3; or they make a double hole with a tongue between them, the coils being wound over the tongue, as in Fig. 4. Sometimes, instead of punchings, slips of sheet iron are used. The slips are passed through the coils, and then bent over at the ends and mixed so as to make a complete iron circuit. The apparatus then takes one of the forms shown in Figs. 5, 6 and 7. In these figures the iron is shown plain, and

the copper coils are shown in section. In Fig. 5 two sets of straight slips are supposed to be taken and bent over at each end, thus making two joints.

In Fig. 6 one set of slips is taken and made into a sort of staple or hairpin; the coils are slipped on and the ends bent over, so that there is only one joint. In Fig. 7 two sets of slips are bent over and mingled at the sides of the transformer. In Fig. 8 two sets of slips are taken, each bent like a hairpin. The inside set is slipped through the coils and bent over at one end; the other set is then slipped in and bent over at the other end. There is still another form which it is not necessary to illustrate, namely, the ring, which may have the copper or the iron inside. All these forms may, for simplicity, be regarded as modification of three types—(1) one link of iron and one link of copper, as in Figs. 2 and 8, and in the ring forms; (2) one link of iron and two links of copper, as in Figs. 3, 5, and 6; (3) two links of iron and one link of copper, as in Figs. 4 and 7. There are a few other varieties, many of them being at first sight somewhat complicated; but on analysis they resolve themselves into one of the three forms described, or multiples of them. That is to say, some of them are really several transformers stuck together.

With a given cross section of iron core and of copper coil and a given induction, it is obviously best to have the copper and the iron circuits as short as possible, provided always that the surface of the transformer is not made too small to get rid of the heat generated. Turning to Figs. 2 and 8, it is clear that if the core section is kept the same the copper is reduced by letting the coils return half on each side, as in Figs. 3 and 6, as the average length of the turns is reduced. The double copper link is thus better than the single as far as the copper is concerned. If, on the other hand, Figs. 2 and 8 are rearranged so that the iron link is split instead of the copper, giving Figs. 4 and 7, the iron is reduced. In the diagrams this is not shown clearly, because the sections of the coils and cores are not the same in the various cases. The double link of iron is therefore better than the single as far as the iron is concerned; it has, therefore, to be settled, whether the transformer should be made with the double iron link or double copper link, and this depends on which gives the largest saving.

The forms of transformer shown in Figs. 5 and 7 appear to have an enormous amount of iron at the ends and sides respectively. It must be remembered, however, that this iron is not highly magnetized, and the watts lost per cubic centimetre are few. so that the heat wasted there altogether is, perhaps, even less than if that part of the magnetic circuit were of the same cross-section as the rest. In this case the enlargement is what might be called accidental, as it is caused by the intermingling of the ends of the slips to make a joint. The universal, or almost the universal, practice is to make the cross-section of the core the same all around where the use of punchings admits of it. There would often be a slight gain in efficiency by using a higher induction in the part of the core that is within the coil.

If the current density in the copper coils is 150 ampères per square centimetre, or 1,000 per square inch, the loss of power per cubic centimetre in the copper is 0.045 watt. In the coils of a transformer of the sizes needed for house lighting, at 2,000 volts on the mains, about half the volume of the coils is insulation, so that the loss in copper is roughly 0.022 watt per cubic centimetre. In the iron, at an induction of, say 10,000 c. g. s. units, there is a loss of 5,255 ergs per cubic centimetre per period. So that at a frequency of 80, the loss is 0.042 watt per cubic centimetre, or about twice the loss in the copper. Even if the transformer is never on except at full load, the loss in iron is thus more important; but when it is generally on light loads, as in houses, the loss of power in the iron is of very much more importance. We may, therefore, take it that the double iron link type is the best.

Tests with Sprague Cars at East Reading, Pa.

Wednesday afternoon, Dec. 18, experimental trips were made with a Sprague motor car on the East Reading, (Pa.) Electric Railway, with most satisfactory results. Chadbourne, Hazelton & Co., Philadelphia agents for the Sprague Electric Railway and Motor Company, had previously extended invitations to a large number of railway officials, prominent electricians and other scientific people, and consequently a very select party of experienced gentlemen were present at the experiments. It is doubtful whether there was ever a more severe test, on a more unfavorable day, or under more trying circumstances than the one alluded to. A steady rain kept the tracks so slippery, and in a condition so adverse to experiments. that a trial with a less perfect machine would have resulted in a total failure instead of proving—as it did—highly satisfactory in every respect to every one present.

The exhibition was in charge of Messrs. J. A. McClure and W. A. Stadelman, of the Sprague Company, and Mr. S. S. Scholl, Superintendent of the East Reading Electric Railway.

Car No. 4, the one used Wednesday, belongs to the East Reading Company, and is their most recent purchase. It has the improved truck, and is equipped with the "Boston" motor. The "Boston" is a double motor, so regulated that a cut-out under the seat of the car makes it possible to operate one or both. Each motor weighs about 1,500 pounds and the entire car 8,500. They are geared to run 15 miles per hour on a level.

The tests consisted of starting and stopping the car with about 35 passengers on curves and grades with one or two motors, showing absolute control and safety, and that in case of an accident to one motor the other would be sufficient to handle the load, while the powerful brakes could be dispensed with if necessary.

Mr. Stadelman, who had charge of the switch, then gave exhibitions of starting and stopping on a level, and while going up a grade, of running down without brakes, controlling the car with the current, and of skidding the car along the tracks. All were equally satisfactory, and so were other tests made.

The Messrs. Chadbourne, Hazleton & Co. have made bids to place the Sprague motors on the Neversink and Mt. Penn railways and on the Penn street branch of the City Passenger Railway Company's lines, and it was for the benefit of the gentlemen interested in these enterprises that the tests were made. The company is placing motors not only in every portion of this country, but throughout the entire world. Mr. Lewis has charge of the mining department, and he has secured the adoption of motors in nearly every mining district of this State. In a few days one agent will sail for South Africa, where he will place a 200 h. p. motor to operate crushers in one of the gold mines, that will be run by electricity carried over 7½ miles of wire.

Several days ago Count Moretti, the president of an electric road in Italy, was in this country, and after having been chaperoned over the United States by Mr. McClure, closed a contract with the company for the erection of a nine-mile road from Florence to Fiezola. W. I. B.

Arc Lights Before the Chicago Electric Club.

Scarcely a fair attendance gathered in the rooms last Monday evening to listen to the interesting compilation of data concerning the growth of the arc-lighting industry, presented by Mr. Charles E. Gregory, of the Sperry Electric Company, under the title of "Comments on commercial arc lighting in Chicago," and for which he was tendered a vote of thanks by the club. Mr. Gregory sketched the growth of arc lighting from the date that Professor Barrett, in 1879, placed a two-light dynamo in the city water works, down to the present day, when he estimates there are some 6,300 arc lights in use, and believes that when the world comes to visit our city in 1892 there will be over 10,000 arc lights in operation.

President Franklin G. Beach presided, and prior to the reading of the paper a considerable amount of business was transac ed. The amendments to the constitution proposed four weeks ago were adopted, after some discussion. By a rising vote the club passed resolutions in memory of the late Mr. E. J. King, of Jacksonville, Ill. On motion of Mr. E. C. Ferguson, a committee of three was appointed to consider the advisability of having a club historian, who shall gather in proper form such facts as may prove of interest and of value both to the scientific and the commercial world in the years to come.

By a unanimous vote, Dr. Louis Bell was invited to prepare a paper on the subject of electric railways, to be read before the club at an early date.

Eleven new members were admitted.

The fact that the club is rapidly attaining a prominent position in the scientific world was adverted to by Mr. F. S. Terry, in the meeting of the board of managers; and believing that the best interests of the club could be served by pursuing a broad and liberal policy, he strongly recommended that suitable arrangements be made with the Eastern electrical journals for a simultaneous publication of the important papers read before the club. Such action, Mr. Terry believes, will result in the club securing papers of such value that they will be copied and commented on by all the foreign technical journals, and will bring fame and honor to this club, and to its doors scientists whom the club shall delight to welcome to membership. F. DeL.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Dec. 21, 1889.

Mr. Lawrence Carter starts this week on a tour through New York State as the representative of the Interior Electrical Conduit Company of this city.

The Gibson Electric Company inform me that their storage batteries are in use on the Wharton car, described last week by your Philadelphia correspondent.

Mr. Paul T. Kenny, formerly with the Empire City Electric Company, is home from a long trip all over the continent. He is making his home at 121 East Ninth street, Oswego, and is open for any engagement requiring a live, active man familiar with the details of electrical trade.

Visitors in Town.—Among the electrical men in town this week have been J. Starr, of Halifax, N. S.; J. R. Markle, of Detroit; P. P. Quackenboss, of Philadelphia; D. E. Evans, of Baltimore; J. F. Blauvelt, of Providence; Eugene Phillips, of Providence, and E. G. Bernard, of Utica, N. Y.

Mr. W. N. Miers, of the Brooklyn Edison Company, has been appointed an inspector for the New York Board of Fire Underwriters. He has spent eight years with the United States Illuminating Company, Archer & Pancoast, and the Brooklyn Edison Company, and is well-equipped for his new duties.

The Huber Dry Cell Pocket Battery is being actively pushed by the Dr. Huber Dry Cell Pocket Medical Battery Company, of 88 Fifth avenue. The battery and accompanying apparatus is most ingeniously gotten up and will undoubtedly meet with a ready acceptance and large sale. It is small, handy, clean, and cheap.

Geo. M. Clapp, 74 Cortlandt street, issues a monthly statement of new and second-hand engines and boilers and general machinery, the which it would often pay electrical men to consult, as thereby they would secure many a bargain. The last list contains a large number of engines of the best makes, and other accessories of a plant.

H. J. Jaeger, the manufacturer of automatic mercury pumps, is busy at his factories, 147 and 173 Pearl street, Brooklyn, manufacturing for the trade. He has lately contracted with the Sawyer-Man Company for 200 of his automatic pumps, and this, as well as a large number of smaller orders, is making things very lively at his establishment.

An Electric Light Challenge.—The United States Illuminating Company and the United Electric Light and Power Company, of this city, have issued an open challenge to the local Edison Company for a competitive test as to safety, etc., the reason given being that the Edison Company has been seeking to prejudice the public mind by unfounded statements.

The Fate of the Subways.—In discussing the situation in New York, the *Engineering News* says: "It is only reasonable, therefore, to assume that all the present miles of pipe-subways are merely a temporary makeshift that must be ripped up and thrown on the scrap-heap in the near future, with the complete obliteration of the capital invested. Under these conditions, the Grand Jury's suggestion of large subways is sound advice; and it would probably be well to consider their cost and plans of construction along with the proposed rapid transit investigation, when that subject reaches the body of experts to whom, we hope, it will be speedily submitted. Underground railways would doubtless be considered, and subways enter vitally into such consideration. But in the meantime let the laws be so changed that the control of all that is now going on may be put into hands better fitted to bring about the best results under the present conditions."

The Van Gestel Electric Street Car Company, 510, 512 and 514 West Thirty-fourth street, have recently issued a circular as to what they are prepared to do in the line of electric light, electric locomotion and storage batteries. As to their car system, they say: "The dummy is an independent car, and only carries the batteries and drivers, which has a capacity of drawing two passenge cars at the rate of ten miles per hour. It is constructed to run either forward or the reverse, or, if necessary, can be instantly disconnected from the motor gearing, thus leaving the dummy or car free. No change is requisite in any of the present passenger cars, this being of great advantage to roads already equipped, saving the cost and necessity of constructing new cars, which is necessary in all other systems in use. The passengers do not come in contact with any part of the electric mechanism or wires, which are entirely confined to the dummy; thus absolute safety is afforded to the public; still more so, as the current used is only of very low tension, unlike all other systems, where the tension of the current is dangerously high." The battery used is the invention of J. T. Van Gestel.

Stieringer Fixture Patents.—A very important suit was commenced recently in the U. S. Circuit Court for the Southern District of New York against the E. P. Gleason Manufacturing Company, manufacturers of gas fixtures, and E. P. Gleason, president, and J. C. Granger, the treasurer of that company, upon the electrical fixture patent, granted to Luther Stieringer June 6, 1882. This patent covers, it is claimed, the modern practical methods now generally used for constructing and wiring fixtures for incandescent lamps, including the universally employed insulating joint. This same patent has been sued on before, a vigorous contest over it having been conducted against the Mitchell Vance Company, which resulted in that company submitting to the patent and the taking of a license under it. Suits are pending at Chicago on other fixture patents of Stieringer owned by the same parties and will be heard by the court probably early in the spring. Mr. Stieringer was a pioneer in this matter of electroliers, having had a large experience in gas fixture work and being, it is said, the first to appreciate the importance of applying correct principles to the construction of electroliers. Anyhow, he says he is very sanguine as to the results of his legal campaign, the above outline of which he gives me.

The Hill Clutch Works, for whom Mr. W. C. Wonham, of 18 Cortlandt street, is so efficient and successful an agent, has issued a neat little card, giving a list of a few of the plants it has equipped. It is as follows: St. Paul Gas Company, St. Paul, Minn., 2,500 h. p.; Minnesota Brush Electric Company, Minneapolis, Minn., 2,000 h. p.; Mt. Morris Electric Light Company, New York. 2,000 h. p.; Buffalo N. Y., Electric Light and Power Company, 1,000 h. p.: Jenney Electric Light and Power Company, Fort Wayne, Ind., 1,000 h. p.; Oakland, Cal., Electric Light and Power Company, 1.000 h. p.; United Electric Light Company, Springfield, Mass., 800 h. p.; Jenney Electric Light and Power Company, Peoria, Ill., 800 h. p.; Jersey City Electric Light Company, 750 h. p.; Topeka, Kan., Electric and Street Railway Company, 750 h. p.; Fitchburg, Mass., Gas Company, 700 h. p.; New Bedford, Mass., Gaslight Company, 650 h. p.; Salem, Mass., Electric Light Company, 600 h. p.; Helena Electric Light Company, Helena, Mont., 600 h. p.; Kansas City Electric Light Company, 600 h. p.; Bloomington City Electric Light Company, Bloomington, Ill., 450 h p.; the Sprague Motor Plant at Davenport, Ia., 450 h. p.; the Sprague motor plant at La Fayette, Ind., 450 h. p.; Norwich Electric Light Company, Norwich, Conn., 400 h. p.; Crawfordsville, Ind., Gas and Electric Light Company, 650 h. p.; Spokane Electric Light and Power Company, Spokane Falls, Wash., 300 h. p.; Harrisburg, Pa., Electric Light Company, 300 h. p.; Atlanta, Ga., Electric Light Company, 300 h. p.; Sedalia Electric Light Company, Sedalia, Mo., 300 h. p.; Huntington, W. Va., Electric Light and Street Railway Company, 300 h. p.: Gore Hotel electric light plant, Chicago, Ill., 250 h. p.; Bangor City, Me., Electric light plant, 250 h. p.; Lawrence, Kan., Electric Light Company, 200 h. p.; Ionia, Mich., Electric Light Company, 200 h. p.; Port Huron, Mich., Electric Light Company, 200 h. p. W. T.H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 8, Cook Building, cor. Franklin and Congress Sts.
Boston, Dec. 21, 1889.

The Bell Telephone Company has declared a regular quarterly dividend of $3 per share to stockholders of Dec. 31, payable Jan. 15, 1890.

Mr. I. R. Prentiss, of the Brush Electric Company, was in Boston this past week, and expresses himself as well satisfied with the prospects of business for the coming year.

The Johnston Electric Train Signal Company have moved their offices from the Equitable Building to the Hathaway Building, 620 Atlantic Avenue.

Whitman, Mass.—The citizens of Whitman expressed themselves at a recent public meeting as being unanimously in favor of an electric railroad to connect Whitman with Boston.

Malden, Mass.—Arrangements will soon be made by the West End Street Railway Company to connect Boston and Malden, through Everett, by an electric railroad, and it is expected to reduce the running time by more than one half. The cars will probably be running by March.

Peabody, Mass.—The plant of the Robinson-Foster Electric Motor Company was sold at mortgagee's sale this week to O. W. Norcross, of Worcester, for $9,500. It is expected that the works will be started again under the management of O. A. Foster, of the old company, a relative of the purchaser.

Claflin & Kimball report the following sales of Mather dynamos: Shoe and Leather Building, Boston, 1,300-light plant; Church Green Block, Boston, 300 additional light plant; U. S. Bunting Company, 250-light plant; G. O. Sanders, Nashua, Mass., 50-light plant; Crocker, Burbank & Co., Fitchburg, Mass., 150-light plant.

Mr. Francis Peabody, Jr., one of the London representatives of the Thomson European Electric Welding Company, has just arrived in Boston, and is reported on good authority to have brought back with him the first payment of $100,000, which has been made on the purchase of the English patents by the European syndicate. The patents for all European countries have now been sold.

Thomson-Houston Electric Company.—At a special meeting of the stockholders of the Thomson-Houston Electric Company, held this week, it was unanimously voted to increase the preferred stock from $1,000,000 to $4,000,000. The price, time of issue and method of disposal will be left to the board of directors. The rate of dividend on the new stock will be seven per cent., the same as the first issue.

Springfield, Mass.—The Board of Aldermen have decided not to grant the Springfield Street Railway the right to use the single trolley system until the Lowell aldermen come to a decision regarding its use in that city. It is reported that Judge Gideon Wells, who will soon become president of the Holyoke Water

Power Company, has stated that the company will erect a $100,000 electric light plant next year.

H. W. Bates & Co. report sales of the following Hunter friction clutch apparatus to electric light companies: Oldtown, Me. Electric Light Company; North Berwick & Salmon Falls Electric Light Company, St. Johnsbury, N. H.; Woonsocket Gas Company, Woonsocket, R. I.; Greenfield Electric Light Company, Greenfield, Mass.; Edison Electric Light Company, New Bedford, Mass.; Excelsior Electric Company, Brooklyn, N. Y.

Wright Electrical Engineering Company have contracts for wiring for incandescent lights four of the car houses of the West End Street Railway Company—the North avenue car house, Cambridge; Boylston street car house, Cambridge; Brooklyn street car house, Cottage Farm, and Grove Hall car house. The lamps, of 100 volts, will be run five in series, and the 500-volt current, which furnishes power to the motor cars, will be used.

Mayor Hart has returned from his trip of investigation as to the price of electric lighting in other cities. He visited New York, Philadelphia and Chicago, and made an extensive inquiry into the prices obtained in these cities, and the mode of operation. He was also much interested in the underground work in Chicago, and has brought back a whole host of facts, which will, doubtless, take shape some early day in a communication to the City Council.

Salem, Mass.—The second pair of 400 h. p. engines, of the McIntosh & Seymour compound type, at the Salem Electric Light Company's station were started for duty last week, making at present 800 h. p. in use there. A preliminary test by Mr. H. C. Patterson, Chief Engineer of the Thomson-Houston Electric Company, who installed the plant, made in conjunction with Mr. McIntosh, of the engine builders, developed results which were more than gratifying. A full test is soon to be made.

Beverly, Mass.—The cars of the Union Electric Car Company came bravely through the trial of the snow storm last week, and ran on time just as usual. Sweepers were used to clean off the heaviest of the snow, but in addition each car is provided with a snow plow in front of each wheel. The Union Electric Car Company have reason to be well satisfied with the success of their cars on this road, and are glad that they were afforded so early an opportunity of testing their cars in such a storm.

Danvers, Mass.—The State Gas Commissioners have given their permission to the Danvers Gas Company to establish an electric plant in Danvers, and President Fette has applied to the selectmen for the right to erect poles and string wires. The selectmen will call a town meeting to decide whether this right shall be granted. There is a general sentiment of opposition, as the town wants to furnish electricity for commercial as well as street lighting, if permission can be obtained of the Legislature.

Robinson Radial Car.—This car is now on daily service between the Boston & Providence depot and Allston, and continues to give great satisfaction by the smoothness of its running and the easy way in which it glides around corners. The car is 22 feet long, six feet longer than the ordinary car, and has six wheels. The motors have been fitted with new coils, which now enable this car to cover the ground at the rate of 30 miles an hour. This car is well worthy of inspection by all electric railway engineers, and it is sure to be very largely used in the future as it becomes better known.

Bristol, N. H.—A stock company has recently been organized in this town, with Mr. George A. Emerson as president, and Mr. L. H. Rogers has just made a contract with them to supply a Brush alternator of a capacity of 1,600 16-candle power lamps. There will be at the outstart sixty 32-candle power lamps for street lighting, and the balance will consist of 16-candle power lamps for commercial lighting. The Brush Company will do all the construction work, and Mr. Phipps, of New York, has already paid Bristol a visit for the purpose of locating the poles. Water power will be used.

Sherman Electric Car.—This car, which has been built in Lowell, Mass., to demonstrate the efficiency of the Sherman patent Electric Clutch, arrived in Boston this week, and is now at the Allston Power House, being prepared as rapidly as possible for an early trial. The car carries a complete set of Sorley (Anglo-American) storage batteries and is fitted with an Eickemeyer motor. The armature of the motor is set in motion before the car starts, and the wheels are put in gear by means of the electric clutch, thus utilizing the momentum of the armature to start the car. The trial is awaited with much interest by many electricians.

Russell Mast Arm in Boston.—On Summer street, opposite the alley between the Estes Press building and the New England building, there has been erected a thirty-five-foot hard pine pole, with a fifteen-foot Russell mast arm and Thomson-Houston arc lamp. The Wright Electrical Engineering Company furnished the pole and the labor of erection, the Boston Electric Light Company will furnish the current, while Mr. John I. Drake, of Providence, very kindly donated the mast arm free of any charge. The light was much required and the mast arm will doubtless attract a good deal of attention, as that quarter of the city is rapidly becoming the heart of the electrical interests of Boston.

Wainwright Manufacturing Company, of Massachusetts, report the following sales of their corrugated copper tube feed-water heater to electric plants: Canada Electric Company, Nova Scotia, 100 h. p.; Edison Electric Light Company, Pennsylvania, 300 h. p.; North Attleboro Steam and Electric Company, Massachusetts, 250 h. p.; Marr Construction Company, Boston, Mass., for Bridgewater, Mass., 150 h. p.; Lewiston, Ill., Electric Light and Heat Company, 75 h. p.; Belfast Electric Light Company, Belfast, Me., 100 h. p.; Denver, Col., Tramway Company, 400 h. p.; Greensburg, Ind., Electric Light Company, 100 h. p. The Wainwright Company are also doing a large business in condensers, expansion joints and separators.

A Novel Sample Case.—Mr. L. H. Rogers, the New England agent of the Brush Electric Company, has hit upon a good idea to help in his sales of the new Brush alternating dynamo. As every electrician knows, the armature of this machine is divided up into sections, any one of which can be taken out while the machine is in use without stopping the current entirely. One of these sections Mr. Rogers now carries around the country in a handsome leather case, which enables him to bring before aldermen and selectmen ocular demonstration of the strong points of the Brush alternator. Mr. Rogers has had a great deal of success in the past six months, having secured every contract he has aimed at, and with this new weapon in his hands he will doubtless show phenomenal results.

Gloucester, Mass., is agitated over the question of an electric railroad, and this week a meeting was held in the City Hall to hear a petition, asking permission to be given to the Gloucester Street Railway Company to erect and maintain the single trolley overhead system of electric propulsion on their proposed extension to Lanesville. Mr. George W. Mansfield, of the Thomson-Houston Company, spoke in favor of the single trolley system, while Mr. I. H. Farnham, of the Telephone Company, advocated the double trolley system. Mr. A. P. Wright gave some disinterested testimony, stating that if there were any danger from a single trolley system, it was just as great with a double trolley system. The matter was referred to the Board of Aldermen, who adjourned until Thursday, when the matter will again be considered.

West End Street Railway.—Guard wires have now been placed on Tremont street, Shawmut avenue and elsewhere on the West End road, and it is now an impossibility for any wire falling from above to come in contact with the trolley wire. The guard wire is strung about a foot above the trolley wire, and is supported by a span wire strung tightly between the poles. There are three guard wires in all, one over each trolley wire and one between these two guard wires. It is of interest to note that the recent snow storm did not affect the electric cars in the least, and that they made much better time than the horse cars, which caused them considerable delay. The six electric sweepers were put in service, and did excellent execution. They are propelled by two motors in the usual method, but have additional motors on the platform of the car for revolving the brushes which clean the streets.

Electrical Men at the Hebrew Fair.—A number of the electrical fraternity of Boston, under the able guidance of Mr. George W. Adams, paid a visit to the fair in aid of the funds to provide a home for aged Hebrew ladies. The party consisted of Messrs. Adams, Frank Ridlon, F. J. Boynton, F. W. Harrington, Alex. P. Wright, O. K. Stewart, Dr. De Bausset, and your correspondent. The fair is one of the most successful ever held in Boston, over $25,000 being realized. The ladies were dreams of beauty and the electrical men fell easy victims to their sweet allurements to take chances in anything from a $100 United States bond to an oil stove for cooking purposes. I have not heard of any other electrical man being successful, but I am now the proud owner of the cooking stove myself, which is on view at this office. Why was it not an electric cooking stove?

A New Switch for Electric Cars.—Mr. L. S. Dumoulin, of the West End Street Railway Company, has applied for a patent on a switch which he intends fitting on the cars of the West End Road. The switch is for the purpose of putting in circuit an auxiliary lamp should the filament of any one of the five lamps break. These five lamps are all in series on the 500-volt circuit passing through them all, and at present, should the filament of one break, all five lamps are cut out, and it is impossible in the darkness to distinguish which lamp is broken. Mr. Dumoulin's switch has six points, the wire coming to the first point, out to lamp No. 1, then to the second point, and out to lamp No. 2, and so on to the auxiliary lamp. Should a filament break, then, by turning the handle of the switch around until it cuts out the circuit of the broken lamp, and also cuts in the circuit of the auxiliary, the circuit being completed, the car is again lighted, and the conductor can then see to substitute the broken lamp at his leisure.

Protection Against Fire.—The committee of the Board of Aldermen on electric wires has reported orders, which were referred to the Corporation Council, that the Board of Fire Commissioners be authorized and directed on and after Feb. 1, 1890, to remove all posts, piers and abutments to which electric wires are attached and which enter buildings, unless there is attached thereto a "safety fuse protector," to be approved by them; that they be authorized to employ one or more persons to remove all dead wires which are attached to buildings or poles within the limits of the city; that they report to the Board of Aldermen the location of all electric clock, fire and burglar alarm, telegraph, district messenger and telephone wires which enter buildings where no "safety fuse protector" is attached, and that no permit shall hereafter be granted for the erection of poles for the support of wires, unless it contains the condition "that all wires and lines which may be connected with the proposed lines of wires which shall enter any building shall have a safety fuse protector attached." In connection with the above order, Alderman Grove stated that the committee did not have time to draft an ordinance covering the points which they contained but it would do so later. The Fire Commissioners have reported in similar vein.

American Circular Loom Company, Hanover, Mass.—This is the name of a new company which has recently been organized under the laws of the State of Maine, with a capital of $100,000, for the purpose of manufacturing insulated wire. The directors are A. F. Smith, George T. Clark, A. A. Brooks and O. K. Stewart. A new patented method of covering the wire by means of a circular loom has been adopted, and judging from the sample of the wire, and the exacting tests to which it has been submitted, it promises to produce results which have hitherto never been attained. The looms, as the name implies, are circular in form, involving an entirely new principle, and strictly covered by patents, and move with the shuttles with incredible speed around the wire, weaving on the cotton instead of braiding it, as other manufacturers do. It is claimed that by this method the covering can be put on much more rapidly, and is put on at a much greater tension, and the strands are very much closer, than is possible by braiding. The covered wire is then saturated by a patented process, and dried and finished. The insulation has an extraordinary resistance to abrasion, is perfectly waterproof and is at the same time fireproof. Tests for insulation in water and for fireproof qualities have been made at the Institute of Technology and pronounced by experts to be highly satisfactory. A specimen of the wire has been submerged in a tank for several months and preserves to-day the same insulation that it had on the day it was immersed. The factory is situated in Hanover, Mass., and is capable of turning out easily 30 miles a day. Orders have already been received for about 750 miles.

A. C. S.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY TRUST BUILDING. PHILADELPHIA, Dec. 21, 1889.

International Printing Telegraph Company will be the name of a new enterprise soon to be incorporated and located in this city.

The George W. Pierce Company, the well-known hardware house, No. 510 Arch street, has added to its stock a full line of electrical supplies.

New Calendars.—The Cleverly Electrical Works is sending out to its customers and friends attractive calendars for the coming year. The enterprising and wide-awake manager of the Cleverly Works is never found lagging in the race.

Mather System.—W. H. Griffiths & Co., agents for the Mather Electric Company and Tucker Electrical Construction Company in Philadelphia and vicinity, report having installed a 75-light incandescent plant for the Hermetis Fire Brick and Clay Company, of Philadelphia.

Mr. C. M. Blanchard, electrical contractor and engineer, this city, has removed his offices from 429 Walnut street to Room 714 Girard Building, corner Broad and Chestnut streets, where he is prepared to furnish specifications and drawings of any class of electrical work.

The Thackara Manufacturing Company, manufacturers of electroliers, gas and combination fixtures, for many years located at the southwest corner of Thirteenth and Chestnut streets, this city, will remove Jan. 1 to their new store and factory, Nos. 1524 and 1526 Chestnut street.

New Storage Battery.—Mr. J. F. McLaughlin of this city, the well-known inventor, has just perfected a new accumulator. It has been Mr. McLaughlin's aim to put in the market a storage battery which would at least equal in efficiency the best now in use, and be able to sell at a profit for about one-half the present price. He claims that he "has accomplished his object," and, after several months' hard labor, he now has a storage battery that will prove of interest to the public.

Edco Motor Cars.—During the past week two experimental electric cars have been running trips on the Darby division of the Philadelphia Traction Company's line between Thirty-eighth street and the suburban town of Darby. These cars are ordinary 16-foot size, and each car is equipped with two 10 h. p. Edco electric motors and Electrical Accumulator Company's storage batteries. This morning one of these cars took a flying trip through the city, traversing the principal thoroughfares and attracting a good deal of attention.

Fottrell Insulated Wire Company, Limited, has its factory at Bristol, Pa., and its principal office at No. 31 South Fifteenth street, Philadelphia. It is the purpose of this company to manufacture cables, wires and insulating tapes under what is termed the "Fottrell" process. No rubber enters into the composition of this insulation, and it is absolutely impervious to the action of acids, heat, cold, moisture and all classes of gases generated in the ground, all of which factors interfere so seriously with the working of wires insulated according to the ordinary methods.

Thomson-Houston Electric Motors.—Mr. Harry G. Clay, Jr., representing in this city the Thomson-Houston Electric Company's stationary motor department, reports business as active, and sales of motors as satisfactory. A day or two ago I accompanied Mr. Clay to the printing house of W. W. Woodruff & Co., 35 North Seventh street, and witnessed the belting up of a 3 h. p. motor which had just been installed to replace a steam engine to operate several large and small printing presses. When the motor was started up the presses worked in a most satisfactory manner; and it is but reasonable to believe that Woodruff & Co. are in an enviable frame of mind to be freed from the nuisance of having coal and ashes heaped about their premises.

Billberg Electric Motor Company.—At a visit recently made by me to the works of Thomas H. Dallett & Co., this city, I had an opportunity of examining this new machine. In appearance it resembles the "Sprague," having similar outlines. The electrical design of the motor is such that the correct position for the brushes on the commutator remains constant for all loads, so the brushes are *permanently* placed at this point, which results in total absence of sparking and reduces the wear on the commutator until scarcely noticeable. The brush-holder is so constructed that the brushes, as they wear, adjust themselves automatically against the commutator at the correct point, and require no attention further than an occasional cleaning. All parts of the motor are made accurately to gauge, and are interchangeable so that they can be replaced in case of accident with but slight delay.

Water Purification by Electricity.—A very interesting subject is the purification of water by the electric current, which is now advertised all over the country by the Stanley Electric Company, 904 Walnut street, for use in cities and towns, and at the hands of very large consumers, by means of which any drinking water, no matter what impurities it may contain, may be rendered perfectly potable in a very short space of time, and the system of reservoirs and pumping machinery now in use may not require to be discarded or changed. Thus, pure water, the greatest and most desirable necessity of the age, can be easily and cheaply obtained by this means. At first glance this may not appear very important, but a moment's consideration as to the value of any process that will free the human race from fevers and even death from typhoidal bacilli and other dangerous microbes is worthy of the very greatest encouragement.

Artistic Metal Work.—Perhaps the best example of ecclesiastical metal work in this country has recently been placed in the new Church of the Covenant, Washington, consisting of the large corona and brackets for lighting this magnificent building. Although the corona is one of the largest combination fixtures for gas and electricity that has yet been made in the United States, its lines are so artistically correct and beautiful that the prevailing impression derived from seeing it in its place is lightness and gracefulness. This work was designed and made by Messrs. de Kosenko & Hetherington, of Philadelphia. The chandeliers for the Inauguration ball, used in the President's room, Vice-President's room, and room for the Diplomatic Corps were also designed and made by this firm. Mr. de Kosenko, a Russian by birth, and educated in the best European art centres, is to-day acknowledged to be at the head of his profession as a designer of art metal-work of every kind. Mr. Hetherington is a prominent member of the celebrated Clover Club, of Philadelphia; the Art Club, the Union League, the Manufacturers' Club, and many others in that city. He is also one of the committee on works of art of the Fairmount Park Art Association, which has done so much for art in Philadelphia. This firm is making the work in their line for some of the finest public buildings and choicest private residences in the country, and have been congratulated on all sides for purity of style, fine mechanical execution, and great originality of design.

The Phonograph is being rapidly brought into a state of perfection that will admit of its commercial use successfully in the near future. It is being reduced in size and increased in efficiency, also improved in adjustment, one of the most notable features being the change to a single-barreled arrangement of the holders of the recorder and reproducer; thus, instead of a pair of spectacles it will be a monocle. The latter adjustment is being rapidly attached to the new machines now being turned out at the Edison laboratory. Several other notable changes are being made in the construction of the phonograph, and a new motor is being made for it by an electric company in Philadelphia that will probably be supplied to the trade very shortly. It is very cheap and, I am told, much more efficient than any hitherto presented, being absolutely regular in its action, no matter what force propels it. This will enable it to reach many other purposes for which at present it is not used. A new diaphragm has been invented by the chemist of the company that is unbreakable, of far better acoustic properties than any other known at present, and very easily and cheaply made. It will probably be used by the telephone companies after the phonograph people have decided as to its use. Its trial has been thorough and practical, and patents are being prepared for the United States and all foreign countries. This will, it is claimed, open a new field for the phonograph and for the telephone, as former difficulties with the metal diaphragms are clearly overcome.

Westinghouse Electric Company.—The Girard Building, in which the office of the Westinghouse Electric Company is situated is one of the future landmarks of Philadelphia, being situated on one of the most prominent corners in the city, viz., Broad and Chestnut streets. While the Girard Building itself is a handsome

one, its electrical features are somewhat novel, it being one of the few buildings in the world without gas pipes. The Girard Life Insurance, Annuity and Trust Company deemed it unnecessary to place gas pipe in the building, depending entirely upon electricity. The building is wired for 2,000 lights, supplied by two 600-light machines and one 250-light machine, of the United States pattern, driven by two Porter-Allen engines, 60 h. p. each, and one Westinghouse standard 25 h. p. engine. In the dynamo room is a switchboard with the necessary instruments, with a switch controlling each floor and each corridor. Situated on each floor is a pocket into which the main circuit is run, and from which run the smaller circuits to each room on that floor. From these pockets any light on the floor can be controlled, switched on or off. In these pockets also are placed the fuses for the entire floor, which are of a uniform size, each fuse carrying practically the same number of lights—not over ten. This avoids the use of various-size fuses and fuse boxes in different parts of the building. Although there is not a wire exposed in the building (being under plaster), yet from the manner in which they are placed no wire is so placed that it cannot be gotten at in a few moments, in case of trouble or repairs. The wire used in this building is the well known brand of White Core Grimshaw, extra heavy. At no time is the building without current, lights being necessary in the rooms, vaults, cellars, shafts, etc., at all hours. The plant has been running about two months without a hitch or a break from the first night it started. The installation was superintended by Mr. F. Herboth, the United States Company's well-known expert, who has charge of the construction of the Philadelphia office. The Pennsylvania Company for the Insurance of Lives and Granting Annuities, another large banking institution, have followed out the Girard Building idea in placing the United States system in their handsome new building opposite the State House, in exactly the same manner—no gas pipes whatever, but depending entirely upon electricity. Their building is wired for 1,000 lights. The Philadelphia manager of the Westinghouse Electric Company reports business particularly good at this season, both in central station and isolated work, having among his orders three large mills at North Penn Junction (in the aggregate 1,400 lights), and construction work upon several other isolated plants, aggregating from 100 to 500 lights each. The Frankford Avenue Merchants' Electric Light Company's station, installed by the Westinghouse Electric Company, has three 35 arc light machines, of the Westinghouse system, running to full capacity. The plant is an immense success. The steadiness of the light and fullness of candle power is justly praised by all who visit the station. Indicator cards have been taken by Mr. W. J. Kerr, Philadelphia agent of the Armington-Sims Company, and they figured 84 h. p. for 105 lights burning, the same being up to guaranteed candle power. The wiring system, being entirely underground in crossing the streets, is the Standard Underground Cable Company's. The construction work on this plant was done by the Marr Construction Company, under the supervision of Mr. Edward Davis, manager of the Philadelphia office. The plant of the Pennsylvania Institute for Feeble Minded Children was turned over to the purchasers some two weeks since. This plant was installed by the United States Electric Lighting Company and consists of 1,000 lights, two United States dynamos and two Westinghouse compound automatic engines. The distance of some buildings from the dynamos is some 1,700 feet, and upon a test there was found to be equal potential in all the buildings, some of which are not 50 feet from the dynamos. The plant started off successfully, and has been the admiration of all who have seen it. This is certainly a model plant, and so simple are the arrangements for manipulating it that it is run by an engineer who never saw a dynamo until these were installed. A plant was also installed by the United States Electric Lighting Company at Morris, Tasker & Co.'s, consisting of one 20-arc dynamo, Weston type, and one 600 light incandescent machine, same make, and the incandescents have been running incessantly and successfully since it started, about two months ago. The Havana steamer "Kansas City" plant, installed by the United States Electric Lighting Company, at Roach's ship yard, Chester, was satisfactorily tested this week in the presence of the owners. This plant consists of an Armington & Sims engine and a 250 light United States dynamo, supplying the incandescent lights for the steamer, with a separate engine and dynamo for a United States search light, which seems to be becoming remarkably popular in this harbor. The Red Star tug-boats "Maryland" and "International" have received their electric light plants, which have been installed in rather a novel way. They each consist of two United States incandescent dynamos, driven by Armington & Sims engines, and are so arranged that the incandescent lights for lighting the boat can be used on either dynamo, two arc lights, with 1,000 feet of cable each (for the purpose of lowering in the hold, taking ashore, on wrecks, loading or unloading) and a 6,000 c. p. search light. The entire plant is interchangeable and the incandescent, arc or search lights can be run from either dynamo.

W. I. B.

WESTERN NOTES.

Branch Office of The Electrical World,
39 Mallers Building, Chicago, Dec. 21, 1889.

The Milwaukee City Railway Company has decided to use electric motors on its lines.

The London, O., Electric Light & Power Company has been incorporated with a capital of $10,000.

The Charles Munson Belting Company, Chicago, have contributed $2,500 to the World's Fair Association.

Mr. Hugh H. Price, of Black River Falls, Wis., owner of the local lighting station, is on a flying business trip to Chicago.

The Omaha Street Railway Company have filed amended articles of incorporation and increased the capital stock to $5,000,000.

Mr. George T. Hewes, formerly of Kansas City, will represent the Electrical Supply Company of Chicago on the road after Jan. 1.

Judge D. C. Metsker, of Topeka, Kan., has agreed to build an electric railway in Sedalia, Mo., in return for certain privileges granted.

The Milwaukee Electric Railway Company has been incorporated by J. A. Hinsey, H. H. Field, D. Atwood, with a capital stock of $5,000,000.

The Grand Junction, Col., Common Council have granted a franchise for the construction and maintenance of a telephone system in that city.

The Vulcan Iron Works, Chicago, are making several hundred castings of iron covers for the Carroll manhole used in the municipal subways.

Incorporations.—Mount Pleasant, Mich., Electric Company; capital $25,000 Twin City Street Railroad Company, of Ironwood, Mich.; capital $25,000.

Mr. C. J. Reilly, late of St. Louis, has returned to Chicago and accepted the position of superintendent of construction of the Excelsior Electric Company.

Mr. G. A. Kinsman, Superintendent of Telegraph of the Wabash Railway, with headquarters at Decatur, Ill., was entertained at the club rooms on Monday.

The Electric Novelty Manufacturing Company has been formed at Chicago by H. E. Chapman, B. A. Todd, A. S Upson and others, with a capital stock of $110,000.

The Nashville Electric Light and Power Company is being interviewed by the Board of Public Works on the subject of overhead wires and the possibility of danger therefrom.

The Knapp Electrical Works has been formed at Chicago to manufacture electrical apparatus; capital stock, $100,000. Incorporators, F. M. Knapp, M. A. Knapp and L. K. Bryson.

Mr. Joseph Kinzie, a well-known business man, president of the Post & Co. Manufacturing Company, died on Dec. 12 at his residence in Mount Auburn, a suburb of Cincinnati, aged 61 years.

Mr. F. W. Best, of Denver, Col., succeeds to the business of the late firm of Kiefer & Best, and will continue to make a specialty of handsome electroliers and combination electric light and gas fixtures.

The Citizens' Electric Light Company, of Helena, Mont., have elected the following officers: President, Wm. B. Sterling; Vice-President, John Worth; Secretary-Treasurer and Manager, H. C. Sterling.

Mr. W. M. Sheldon, general agent of the Schuyler Electric Company, has favored Chicago with his presence during the week while arranging matters connected with the opening of their Chicago offices.

Mr. S. W. Trawick, manager of the Chicago office of the Excelsior Electric Company, has sold a 30-arc light machine and a 600-light Slattery alternating incandescent machine to the Murphysboro Electric Light Company.

Mr. Emile Kahn, President of the Cincinnati Electric Engine Company, visited Chicago during the week, arranging with the Chicago Arc Light and Power Company for the placing of his constant current motor on their circuits.

Mr. F. J. Baker, manager of the Chicago office of the Daft Electric Company, has returned from Bloomington and reports that the city railway will have the Daft system in full operation by Jan. 15, ten miles being nearly completed.

Mr. C. A. Brown continues to awaken interest among the Western manufacturers on the subject of the abolition of the duty on copper, and the progress thus far made is most encouraging. Yet Mr. Brown must have the loyal support of every one interested in the matter to enable the desired end to be secured.

Mr. W. H. Mack, who has been representing the Brush Electric Company for some time, has resigned, to accept the management of a large plant in Sioux City, Iowa. Mr. Mack's pleasant face will be missed at the club rooms, where he was a constant attendant.

The Electro-Matrix Company, of Minneapolis, elected the following officers at their annual meeting on the 5th inst.: President, William M. Grosvenor, of New York; Vice-President, C. L. Travis; Secretary and Treasurer, C. Wright Davidson, both of Minneapolis.

The Electrical Supply Company, Chicago, have received an extensive supply of their Stellar incandescent lamps, which are said to combine brilliancy, with strength of filament and long life, without blackening while in use. These lamps will be made to fit any socket.

The Central Electric Company, Chicago, report that they have secured orders practically consuming the entire product of the Okonite factory for some time to come, and were it not for the heavy stock now on hand they would be compelled to let many orders pass over.

Excellent Workmanship.—A brass casting of unusual size and finish was carried through the streets a few days since attracting much attention. Inquiry developed the fact that it had been turned out by J. J. Ryan & Co., of Chicago, for an electrical railroad company.

Mr. C. H. Wilmerding, treasurer of the Chicago Arc Light and Power Company, is bringing out a very neat spark arrester to be placed above the globe on arc lamps. The body is made of No. 20 mesh wire gauze held in shape by a light tin frame, hinged to permit of being easily removed.

Mr. James R. Dee, the genial Peninsular "boss" of power and light and telephony in the mining regions, dropped down from his northern home at Houghton, Mich., to arrange for further additions to his extensive plants. Mr. Dee will be at the convention with a fresh lot of good stories.

The Madison Shipyard Company, Madison, Ind., have contracted to construct three boats, 46 feet beam, 200 feet long, engines 20 inches diameter, 7 feet stroke, four boilers 42 inches diameter, 22 long, four 10-inch flues, electric lights, and all to be completed June 1; total cost, $200,000.

St. Louis, Mo.—A fire occurred on Dec. 20 in the Guernsey Building, in the basement of which the Guernsey-Scudder Electric Company had their plant. The total loss from the fire is put at $250,000. Electricity is blamed as usual, but no evidence to show that the fire was of electric origin has been adduced.

Mr F. W. Cushing, Secretary of the Central Electric Company, is pushing the work of renovation in their proposed new quarters on Franklin street, and by Jan. 10 he expects to be comfortably settled therein. Mr. Cushing says that it will be the handsomest and most convenient supply house in the country.

Myron Alexander Knapp, of Chicago, has established a most excellent reputation as an after-dinner speaker, and on one occasion during a recent trip to the Pacific slope delighted his hearers to such an extent that they voted to present him with a blank franchise, the majority being members of the City Council.

Mr. Frank A. Wunder has accepted the Western agency of the Schuyler Electric Company, and will open his headquarters at 121 La Salle street, Chicago. Mr. Wunder's extended experience both in arc and incandescent lighting and in the installation of plants will now stand him in good stead, and aid in rendering his success certain.

Muskegon, Mich.—The Muskegon Railway Company has four and one-half miles of electric railway in process of construction, and it is expected that the road will be in operation by Dec. 25. Important extensions will be made in the spring, and the road will be one of the most complete, electrically, in the Northwest. The Short system has been adopted.

Mr. Brainard Rorison returned to Fort Wayne last week after an extended trip, covering the Southern and Southwestern States. In addition to his duties as secretary and treasurer of the Fort Wayne Electric Company, Mr. Rorison is also serving as president of the Louisiana Electric Light and Power Company, of New Orleans, and as a director in the Municipal Electric Light and Power Company, of St. Louis.

The Southwestern Electrical Engineering Company, the incorporation of which was referred to in The Electrical World of Dec. 14, have opened their headquarters at 515 Walnut street, St. Louis, Mo. The officers of the company are C. J. Briner, president and manager; C. R. Meston, secretary, and A. Irvine, superintendent. Mr. Briner has been connected for over eight years with the electrical supply and contract business, and was lately the vice-president of the Central Electric Construction Company, of that city, which has been absorbed by the Leonard & Izard, Company, of Chicago.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$308@$310	Cumberland	$ 68@ 69
Central Union	58@ 59	Wisconsin	113@ 115
Michigan	92@ 95	Bell of Missouri	150@ 151
Great Southern	31@ 32	Iowa Union	23@ 25
Colorado	35@ 38	Missouri and Kansas	57@ 58
Rocky Mountain Bell	40@ 41		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$73@$76	Chicago Edison Co	$105@$106

Cincinnati, Ohio.—The South Covington & Cincinnati Street Railway Company, with a finger on the pulse of the public, has adopted the double overhead wire parallel system for the two divisions of its line. The Short Electric Railway Company has the contract for the electrical equipment, which will be eight miles of overhead construction and twenty cars. The Short safety guard wire, which, it is claimed, will prevent all accidents due to falling wires, will be applied over the entire system. Work on the roads has already begun, and it is expected that they will be in operation in a few weeks.

Mr. Tom. L. Johnson, the street railway manager of Cleveland, says his company is perfectly willing to pay a certain proportions of its earnings to the city in return for the granting of a certain franchise. "As a citizen," said Mr. Johnson, "I am in favor of taxing street-railroad franchises." It ma be added that he is not in favor of taxing the track and rolling stock and equipments, for the reason, as he puts it, "that the public are entitled to the best service possible for the least money." His notion is that this can be secured by taxing the value of the franchise and exempting everything else from levy.

The Hon. Clem Studebaker, whose palatial mansion at South Bend, Ind., was partially destroyed by fire just prior to the reception tendered to the Pan-American delegates by Mr. and Mrs. Studebaker, has contracted with the Electrical Supply Company, of Chicago, for the complete installation of 2,700 feet of the "interior conduit" system, to contain the electric light wires that will shortly be drawn in, openings being left for the necessary outlets, some 100 in number. In addition, 200 feet of this interior conduit will also be used for holding the wires employed in the operation of house bells, burglar alarms, etc.

The Commercial Electric Company, Detroit, has the contract for furnishing an electric light plant for the Detroit Sanitary Works; also for doubling the capacity of the electric light plant recently put in by the company of Stearns & Co.'s laboratory, and has just completed the installation of a 250-light dynamo at the Detroit *Free Press* Company. A large force of men are busy wiring the new Hammond Building and several large factories and stores, which will be lighted by the Detroit Electric Light and Power Company. The D., G. H & M. Railroad Company has contracted to use the system throughout its Brush street depot.

A Kansas City Electrical Society.—The electrical fraternity of Kansas City held an informal meeting at the Hotel Meidland last Saturday evening and laid the foundation of an electrical society. General manager W. W. Smith, of the Missouri and Kansas Telephone Company was chosen president; H. C. Sprague, superintendent of telegraph of the Fort Scott & Gulf Railway, first vice-president; G. W. Bronson, second vice-president; A. M. Barron, superintendent of the House District Telegraph Company, secretary, and F. K. Holtzinger, treasurer. Committees on by-laws and constitution were appointed, and the society will be permanently organized at the Midland this week. Nearly one hundred gentlemen have signified their desire to join.

Cincinnati Electric Light Bids.—The bids for lighting the city of Cincinnati were opened on Tuesday by the Light Committee of the City Council. Three bids only were submitted. The Cincinnati Electric Light and Power Company, represented by Amor Smith, Jr., bid $63.25 per lamp a year; the Cincinnati Electric Light Company, represented by General Hickenlooper, bid $73.89½ per lamp per year, and the Brush Company bid $59.98 per lamp per year, or a fraction less than $5 per lamp per month. As soon as the Brush bill was read, Mr. Mullen found fault with the specifications under which the bids were made. He found that the specifications do not fix the price to be charged for private lighting, and his motion to adjourn subject to the call of the chair was carried.

The Interior Conduit System.—The Chicago *Herald* of last Saturday, in referring to the Boston fire, says: "It is the electric wire that is imbedded in the building beyond the reach of inspection and within the reach of mice that is the source of danger. What insurance people and the insuring public most need is a wiring system that is safe." Commenting thereon, Mr. F. S. Terry said: "That safe system is already here, and is being placed in some of the most extensive buildings now in course of construction, simply because the owners found that its use permitted of the wires being withdrawn and replaced as often as desired, and that a crossing of two wires of different carrying capacity is impossible in buildings having this interior conduit system. And it is as safe from the attack of rats and mice as gas pipes are, owing to the nature of the material from which it is constructed."

The Jefferson Davis Executive Committee, at New Orleans, in settling for the expenses incurred in connection with the funeral ceremonies, received the following letter from Mr. Maurice J. Hart, of the Louisiana Electric Light Company, saying "they were glad they had been able to contribute in their line of business to the manifestations of respect and grief shown by our people for the illustrious dead," and adding: "Permit us to consider the services we were able to render in the light of a tribute of respect for the great chieftain, as well as the desire to aid the city administration in the performance of its sad duty on that occasion," etc. The letter was received and the thanks of the committee returned to the company. President Bofinger, of the American District Telegraph Company also contributed the services of numerous messengers who had been employed during the ceremonies. Thanks were also returned to him.

S. A. Barton, says the Chicago *Herald*, of the Thomson-Houston Electric Company, of Boston, will be president of the New Electric Mutual Insurance Company, soon to be launched upon the insurance sea. The careless method of constructing electric light stations has led the insurance companies either to decline them entirely as risks or charge a rate which was practically prohibitive. The new company will be mutual and comprise all station owners who desire to avail themselves of the benefits of insurance at cost and take their chances as to what the cost will be. Mr. Barton is an electrician of acknowledged standing, and a man of marked executive ability. If he succeeds in making a success of the company it will be

because he will succeed in making insurable risks out of the electric light stations. Edward Atkinson has made his wonderful success with the New England Factory Mutuals by making the factories reasonably safe from fire. Special hazards must be carefully protected and thoroughly inspected, and then they are good risks. If the electric station owners would adopt the measures which their mutual company will doubtless enforce for the prevention of fire they would have no trouble in securing insurance from the regular companies at fair rates, and there would be no need of a mutual company for them. However, the formation of the company will doubtless result in many radical and much-needed reforms in station construction and operation, and will thus be of much practical service to the electric people, who will have to foot the bills.

F. DE L.

THE TELEGRAPH.

Pine Bluff, Ark., proposes to put in a fire alarm system.

Parkersburg, W. Va., is putting in the Gamewell fire alarm system, with 60 boxes.

Texas.—The San Antonio & Aransas Pass Telegraph Company has been formed, with a capital stock of $200,000. It will operate in connection with the postal system.

Chinese Cable Rates.—The Chinese Foreign Office has ratified the Che Foo agreement under which the Chinese-European telegraph companies reduce their tariff to two dollars a word. Foreign telegraph companies by this agreement acquire means of communication with Hong Kong, Shanghai, Amoy, and Foochow, and the Chinese telegraphic communication with the rest of China. Each company transmits the messages of the others gratis.

THE TELEPHONE.

South Carolina.—The Greenville & Pickens Telephone Company has been formed to build a line between those two places.

Molecular Telephone.—Some of our readers may be interested to know that among some miscellaneous stocks sold in New York this week were 10 shares of Molecular Telephone, original issue. It sold at 2, or one-fiftieth the par value.

The San Francisco Exploiting Company has been formed by G. H. Bradshaw, W. D. Walker, W. B. Johnson, L. Goldstein and others, to buy and sell phonographs throughout the country. It has a capital stock of $1,000,000 and a capital of $1,000 cash subscribed.

Telephone Wires in Boston.—President Sherwin, of the New England Company, informed the Aldermen last week that of the 5,168 miles of wire operated by the company, about 3,368 miles had been put underground, and 1,400 more in aërial cables. The fusible strip device had been tested for two years, and is entirely efficient.

THE ELECTRIC LIGHT.

Moundsville, W. Va., is talking about an electric light plant.

Ocala, Fla.—G. W. Brown will organize an electric light company.

Antwerp Village, N. Y., has granted a franchise for a Brush plant.

Shepherdstown, W. Va.—It is proposed to put in a Westinghouse plant.

Pulaski City, Va., will issue bonds for water works and an electric light plant.

Lexington, Va.—The Virginia Military Institute is to have an electric light plant.

Elizabeth City, N. C.—Guirkin & Co. are reported as proposing to increase their plant.

Dendron, Va.—The Surry Lumber Company have been putting an electric light plant in their mill.

Fort Payne, Ala.—The Fort Payne Electric Light, Power and Heating Company will increase its plant.

El Paso, Tex.—The El Paso Electric Light Company has increased its capital stock from $100,000 to $250,000,

Lynchburg, Va.—The Piedmont Electric Illuminating Company will increase its plant and put in a 125 h. p. engine.

St. Augustine, Fla.—The Edison electric light plant in the Ponce de Leon Hotel is being overhauled and improved.

Cumberland, Md.—The Baltimore & Ohio Railroad Company, of Baltimore, propose putting a plant in the Queen City Hotel,

Anniston, Ala.—The Anniston Gas and Light Company have contracted for an additional Thomson-Houston 50 light machine.

Van Buren, Ark.—R. H. Browne has petitioned the City Council for a franchise. It is said a Thomson-Houston plant will be put in.

New Decatur, Ala.—The Louisville & Nashville Railroad Company, of Louisville, Ky., proposes to put an electric light plant in its New Decatur machine shops.

Tallapoosa, Ga.—The Edison plant to be put in by G. F. Quackinbush & Co. will be one of 270 lights, but in all probability the capacity will have to be doubled within the next six months.

Marseilles, Ill.—The Marseilles Street Railway and Electric Light Company has been formed by J. Montgomery, J. Smith, and J. F. Clark, with a capital stock of $30,000, to operate lights and an electric railway.

Macon, Ga.—An electric light plant is being put in the Macon Barrel Factory. The American Water Gas Company, which has bought up the water, gas and electric plants, has begun enlarging the electric light outfit.

McKinney, Tex., is about to establish a central station plant of 500 lights capacity. The Westinghouse alternating current system has been adopted. The parent company operates at present fifteen central station plants in the Lone Star State.

Liberty, Va.—The Bedford Electric Company has just been formed at Liberty, to put in a complete electrical plant for arc and incandescent lighting and electric railway work. For arc work the Schuyler system has already been selected. The other equipments will be decided upon later.

New Haven, Conn.—The New Haven Electric Light Company has made a proposition to the committee of the court of Common Council on lamps, agreeing to furnish twice the present number of lights of 1,200 c. p. for 37 cents each, provided the city gives a long contract, the new lamps not to be scattered so widely as are those heretofore located. The city has now 157 electric lights of 2,000 c. p. each and pays 50 cents per light.

No Electric Lights in Catholic Churches.—The priest of the Archdiocese of New York had a conference last week in the Church of St. Michael the Archangel, Thirtieth street and Ninth avenue, of which Monsignor Donnelly, the Vicar-General, is pastor. It was presided over by Archbishop Corrigan, who made a special request to the rectors that no electric lights be used in Catholic churches until their safety has been clearly demonstrated.

Bloomington, Ill.—A dispatch from Bloomington, Ill., says: "The Westinghouse Electric Light Company was awarded a $30,000 contract by the Citizens' Gas Light and Heating Company of this city, for the construction of an arc and incandescent electric plant, to be operated in connection with the company's gas plant. From $50,000 to $75,000 will be expended. This will be the third electric plant in the city, and, with the street railway plant now being constructed, will be the fourth."

Savannah, Ga.—The Brush Electric Light Company is about to push out into new fields. It contemplates making arrangements for introduction of the Westinghouse fuel gas into this city. If its efforts are successful illuminating gas will be added. This will be done to allow the company to reach small consumers who do not use electricity. At the same time President Hamilton says it will push the introduction of electric incandescent lights as a means of illuminating private residences. Five lights have been selected as the minimum that will be placed in any one house. A charge of about $2 per light is made for introducing the wires. Meters are attached, and a charge of one cent an hour is made for each light used. A number of houses are now illuminated in this way.

Westinghouse Plants.—The shipments of the Westinghouse Electric Company of alternating current apparatus for eleven months of the year 1889, ending Nov. 30, amounted to a capacity of 223,600 16 c. p. incandescent lamps. During the entire year 1888 the total amount of business represented a capacity of 106,200 16 c. p. lamps, and during 1887 119,950 16 c. p. lamps, making for those two years a total capacity of 226,150 16 c. p. lamps. From these figures it is not difficult to gather the fact that the total amount of business done by the Westinghouse Electric Company during the year 1889 will more than double the amount of last year's business, and it will even exceed the combined amount of the business accomplished during 1887 and 1888.

Electric Lights in Colorado.—The popularity of electric lighting in Colorado has obtained another stimulus in Denver. The Consolidated Electric Company of that city has just placed an order with the agent of the Westinghouse Electric Company contracting for alternating current apparatus of a capacity of 3,000 incandescent 16 c. p. lights. The Denver company has been run very successfully from the very moment of its organization, when it established a central station plant of 6,500 lights capacity fitted up with apparatus of the Westinghouse alternating current system. This was in the early part of 1887. Owing to the enormous growth of its business the plant had to be repeatedly increased. First apparatus for 2,600 lights were added, then 1,700 lights, then again last spring 3,000 more lights had be called into requisition. This latter order has just been duplicated and when the Westinghouse company has shipped the apparatus the Denver alternating current plant will have apparatus of a total capacity of 16,800 incandescent 16 c. p. lights.

APPLICATIONS OF POWER.

Gloucester, N. J., will probably have an electric road running to Billingsport next year.

Laredo, Tex.—An extension of the electric road of the Laredo Improvement Company is proposed.

Richmond, Va.—Major B. J. Black states that the electric road to Petersburg will be built in the spring.

Knoxville, Tenn.—The Knoxville Street Railway Company has made arrangements for its Beaman Lake electrical extension.

Macon, Ga.—The Macon City & Suburban Street Railroad Company's tracks are being rapidly converted into an electrical line.

Nashville, Tenn.—The United Electric Railway Company is the name under which the South Nashville Street Railroad Company and the Nashville & Edgefield Street Railroad Company have just combined.

St. Louis, Mo.—The British American Investment Company is backing up a project for the construction of an elevated electric railway in St. Louis. Work is to begin at an early date, as all the capital has been subscribed.

Cure for Rheumatism.—The electric cars are believed to be a great help to people afflicted with chronic rheumatism. "I don't know as there is anything in it," said a sufferer, "but after every ride my pain seems to be less." He takes his constitutional in an electric car, and is as cheerful as the sun.—*Hartford Post.*

PERSONALS.

Prof. J. B. Barrett, the "electric king" of Chicago, has been on a visit to the East, and was in New York last week.

Mr. Paul Seiler, of San Francisco, has been engaged piloting through the Eastern States the Chinese capitalists who are now in this country buying electrical plants and material.

Mr. Alfred Cowles, of the Cleveland *Leader* and Chicago *Tribune*, and well known among electricians from his active interest in the electrical extraction of aluminium, died at Chicago last week.

Mr. John Starr, of Halifax, N. S., representing the Lahmeyer system and other electrical interests, was in New York last week and called at this office. He reports electrical business as fairly progressive in the Dominion. His son has been engaged installing a number of plants in the Maritime Provinces.

Mr. Jerome Hennessey, superintendent of telegraphs for the Nicaragua Canal Company, committed suicide last month while making a trip to San Juan. He was ill from fever, and at times delirious, and while shooting at alligators turned his revolver against himself. Mr. Hennessey was well known in telegraphic circles, having been employed by the Western Union Company for many years. Just before joining the Nicaragua Canal Company he was in the employ of the Mexican Telegraph Company. He was not married. He had relatives residing in New York City and Albany

Rev. W. J. Haven, of Boston, preached recently on "The Single Trolley Wire." The reporter says: "The speaker described how the present electric system was developed through experiments with a needle, and went into the technique of electricity. The preacher drew a beautiful parallel, likening a wire charged with electricity to the Saviour. We find there is an enormous saving in the new street-car system over the use of horses. A man will stand a certain shock of this electric current, but cannot stand coming in contact with a 300-cell wire, for it will burn out his body." This reporter certainly deserves promotion. But how about the preacher and editor?

Mr. E. G. Bernard, who has represented the Sawyer-Man Company so long and ably, has just placed to his credit the order for his fortieth knitting mill, the plant being one for a mill at Herkimer, N. Y. His record is nearly as good on silk mills, of which he has now equipped about thirty. His work stands the test of time, and the equipments are all highly spoken of by their owners. Blood & Stewart, of Amsterdam, N. Y., have had a plant running nearly four years, night and day, and often with 246 lights on a 200-light machine, but there has been satisfaction throughout. They find no wear on the commutator, and the brushes have never been renewed, the first set put on being good now for at least two or three years.

MISCELLANEOUS NOTES.

The Asheville, N. C., gasometer blew up last week, killing two men and wounding two. Only twenty lines in the papers.

Another Subway Explosion occurred in this city, Dec. 21, scattering passers-by, dirt, stones and manhole in every direction.

Wire Cutting in New York.—During the recent crusade there have been removed a total of 472,692 feet of wire and 338 poles.

The State Electrical Executioner is worrying the Board of Health in this city to "abate the nuisance of high-pressure currents on electric light wires."

A Candle Fire in Detroit last week caused the death of three children, while many others are still dangerously ill from burns and smoke inhalation. The papers mention the affair briefly.

Montreal, Can.—Mr. J. Carroll has been elected secretary and treasurer of the Eugene F. Phillips Electrical Works at Montreal, as already announced, and begins his duties immediately.

Shihlok Jugigo, a Japanese murderer, has been sentenced by Judge Brady in the New York Court of Oyer and Terminer to die by electricity. He is the third on hand awaiting electrical execution.

"New Diseases."—An article traveling through the papers includes among the new diseases several that are attributed to the telegraph, telephone and electric light. The electric motor was overlooked and so was the push button.

Electric Sugar Swindle.—Recorder Smyth has denied the motion for a suspension of sentence made by the district attorney in the case of the electric sugar swindlers who had pleaded guilty to grand larceny, and allowed them to change their plea to one of not guilty.

Court of Patent Appeals.—Senator Gorman has introduced a bill in the U. S. Senate to establish a Court of Patent Appeals of the United States, which shall consist of a Chief Justice and five Associate Justices, to be appointed by the President. The Justices are to receive a salary of $8,000 a year. All cases relating to patents, etc., now pending before the United States Supreme Court shall be transferred to and heard by the Court of Patent Appeals, and all appeals will be to that court.

The "Peral" Boat.—A special dispatch from Madrid, of Dec. 2, says: "The submerging trials of the submarine boat 'Peral, have taken place in the open sea with excellent results. The boat appeared and disappeared from the surface of the water with incredible rapidity. It was submerged to a depth of seven metres, and remained beneath the water forty minutes. The total time that the boat was under water was two hours and a quarter. The inventor, Señor Peral, was congratulated as victor by the immense assemblage present to witness the trials."

BUSINESS NOTICES.

The American Institute Fair closed Nov. 30, and the medal of superiority was again awarded to the Jerome-Kidder Manufacturing Company, 820 Broadway, New York, for their celebrated electro-medical apparatus and appliances.

Garvin Universal Milling Machine.—E. E. Garvin & Co., of Laight and Canal streets, New York, have issued a new circular describing their universal milling machines, and setting forth some of the different uses to which the same are applicable. Besides this it explains the different operations and gives a detailed example in bevel gear cutting which will be found instructive to beginners. Copies can be had free upon application.

Tests with a Russell Engine.—In speaking of an evaporation test made with a 100 h. p. Russell engine at the light station of the National Electric Construction Company, Chicago, it was stated that the consumption of water per indicated horse-power at an average load of 76 h. p. was 37 7 10 pounds, and that this, with a single-valve engine, under the existing circumstances, was a remarkable showing. This statement was incorrect, as the record made was 31 7-10 pounds, instead of 37 7-10 pounds. The four Russell automatic engines mentioned as having been sold to the West Division Cable Company are to be furnished and put in by the National Electric Construction Company, of Chicago, who will secure them through the Rice & Whitacre Manufacturing Company.

Praise from the Pacific.—Electrical progress has been so rapid as to develop a bewildering vocabulary not found in the latest revisions of the great dictionaries. This multitude of new words is a source of much perplexity, and many a puzzled newspaper reader will be glad to know that a "Dictionary of Electrical Words, Terms and Phrases" has been prepared by so eminent an authority as Prof. E. J. Houston, of the Franklin Institute, and is published by The W. J. Johnston Co., Limited, of New York. The work includes about 2,500 words, terms and phrases, whose definitions are made clear by many illustrations and a general statement of the principles of electrical science on which the definitions are founded.—*Amador, Cal., Ledger.*

Montana, Oregon & Washington.—The wonderful richness in natural resources of the country occupying the extreme northwestern portion of the United States is daily attracting to this region large numbers of people for settlement, and this movement is fully justified by the circumstances. Montana is producing a greater wealth of the precious metals at the present time than any other State or territory. This territory is also rich in lumbering and agricultural interests. Washington territory, with its mild climate, is remarkable for the fertility of its soil, the magnificence of its forests and the size and quality of its fruits. The Northern Pacific Railroad, running Pullman sleepers, dining cars and free colonist sleepers through to the Pacific coast, is the only line crossing Montana from the eastern to the western boundary, and is the only through car line to Washington territory. For full information relative to the country traversed by this line address your nearest ticket agent, or Charles S. Fee, general passenger and ticket agent, St. Paul, Minn. Send for illustrated pamphlets, maps and books relative to the Pacific Northwest.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED DEC. 10, 1889.

416,712. Electrical Annunciator; Franklin S. Carter, of Burlington, N. J. Application filed April 12, 1889. In an annunciator, the combination of setback or tripping mechanism and pointers, or indicators, having their pivots connected to and moving with the tripping mechanism independent of the dial plate.

416,713. Method of Protecting Railway Trains; Joseph I. Conkling, of Brooklyn, N. Y. Application filed Dec. 20, 1888. The method of protecting railroad trains and recording the circumstance of their stopping, consisting in electrically signaling to the train dispatcher's office the stoppage of a train from a point adjacent to the rear of the train, and indicating such signal at a point adjacent to the front of the train; then signaling the stoppage at the dispatcher's office from a point adjacent to the front of the train; then signaling the train number and designating symbols for the location of the stoppage, and automatically recording such signals at the train dispatcher's office, whereby a permanent record is made of the stoppage, the train which was stopped and the place at which it stopped.

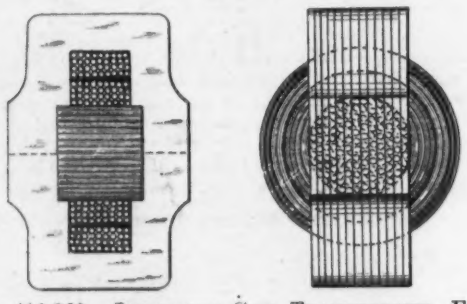
416,720. Commutator; J. Allan Dalzell, of Hartford, Conn., Assignor to the Schuyler Electric Company, of Middletown, Conn. Application filed Oct. 26, 1885. As a new article of manufacture, a commutator, consisting of a disc of slate secured between hubs or flanges of metal upon a shaft, and provided with metallic segments or plates removably fastened to its outer periphery, and in metallic connection with studs or pieces of metal secured in openings drilled in the material of the disc.

416,732. Telegraph Transmitter; Orville D. La Dow, of Mechanicsville, New York, Assignor of one-half to Frederick T. Bickford, of Washington, D. C. Application filed April 3, 1889. In a telegraph transmitter, the combination of a non-conducting feed roller rotating at a uniform rate of speed, a conducting plate or comb arranged adjacent to the roller, a series of sectors having conducting and non-conducting spaces arranged out of contact with the feed-roller, and a series of key levers for bringing the sectors into contact with the roller.

416,746. Coupling Electric Motors; Edwin Wilbur Rice, Jr., of Lynn, Mass. Application filed May 7, 1888. The method of equalizing or proportionately distributing the load between two or more electric motors running together, and having field coils in independent branches, consisting in making the flow of current to the field coil of each dependent upon the counter electromotive force of the other or others. See illustration.

416,754. Telephone Switch; Joseph Sack, of Dusseldorf, Germany. Application filed Jan. 4, 1889. Patented in Germany June 10, 1887. The combination of lever with plates, levers, posts, springs, and with the lever, stop and springs.

416,762. Induction Coil, Transformer, etc.; Elihu Thomson of Lynn, Mass. Application filed Sept. 26, 1887. In an electric inductorium or converter, or its equivalent, the combi-



NO. 416,762.—INDUCTION COIL TRANSFORMER, ETC.

nation with a hollow frame of iron formed of a series of superposed iron plates having a central opening or aperture, of a separable core piece of iron carrying the electric coils and formed of a bundle of iron plates whose ends make a butt joint with the edges of the plates forming the hollow frame when inserted into the central opening with its coils applied. See illustration.

416,803. Voltaic Belt; Frank A. Phillippi, of Reading, Pa., Assignor of three-fourths to Charles J. Clark and Samuel Lutz, of same place. Application filed May 7, 1889. A belt and metallic strip secured to one side of the belt by means of conducting attachments extending through the belt, and a waterproof flap attached to the belt and adapted to fold over the strips, in combination with a chain of cells constituting an electric battery, and means for attaching the ends of the chain to the strips.

416,808. Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed June 1, 1888. The combination, with a spring-jack switch, consisting of the lever normally pressing against its contact point or anvil and the insulated test ring or piece, of a test plug adapted to be inserted therein, the test plug containing three terminals, whereby on inserting the test plug in the spring jack switch three separate connections are made, one terminal of the plug being connected with the anvil, another with the switch lever, and the other with the test piece, while the lever of the switch is at the same time lifted from its anvil.

416,809. Test Circuit for Multiple Switch Boards; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed June 1, 1888. The invention consists in two buzzers or indicating devices, in different circuits and batteries connected therewith, and a test plug having two terminals, one terminal being connected with the circuit of one indicating device, and the other terminal being connected with the circuit of the other indicating device, the test plug being of such form and the indicating devices being so adjusted with respect to resistance and current that when the test plug is inserted in any spring jack of a line not in use the two indicating devices will respond one after the other. If, however, the line tested is open or connected with another line on either side of the spring jack at which the test is made, only one of the signal indicating devices will respond.

416,847. Hanging Device for Electric Arc Lamps; James McLaughlin, of Chicago, Ill. Application filed Aug. 24, 1889. In a hanging device for electric lamps, the combination of a ceiling board, a roller of insulating material on the ceiling board, and from which the lamp cables are suspended, conductors on the roller connecting the lamp cables with the terminals of the line-wire teeth upon the roller, and a worm, supported in mesh with the teeth of the roller and provided with an arbor.

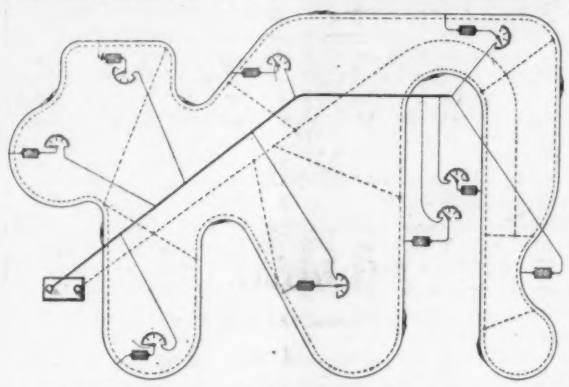
416,862. Benjamin Schardt and William Lutzenberger, of Dayton, O., Assignors of one-third to Hermann Pretzinger, of same place. Application filed May 2, 1889. The nature of the invention consists in a case or shield permanently suspended on a supporting table, and in which is a spring actuated catch to attach and detach an arc lamp and connective parts in the case to make the requisite electric circuits for the arc lamp, the same being raised and lowered by means of a cord and pulley.

416,873. Cutting Metal by Electricity; Benjamin C. Tilghman, of Philadelphia, Pa. Application filed July 27, 1889. The process of cutting or abrading metals, which consist in heating, by an electric current, successive small portions of the metal surface and simultaneously removing the heated metal by an abrading-tool.

416,910. Trolley-Holder; Wilton F. Jenkins, of Richmond, Va. Application filed Jan. 26, 1889. In a trolley-holder, the combination, with a laterally yielding support having a slotted guide at its lower end, of a main stem to which the support is pivoted and a weighted trolley hanger pivoted at the upper end of the support.

416,971. Electric Door Alarm; Edwin W. Taylor, of Charlottetown, Prince Edward Island, Can. Application filed March 23, 1889. The combination, with a lock casing and its bolt or latch, of a chambered block of insulating material, a spiral contact spring projecting from the chamber in the direction of the length of the latch or bolt and in the path thereof, and the electrical connections.

417,009. Telephone Transmitter; Joseph C. Eichmeyer, of Utica, N. Y., Assignor of nine-tenths to Frank J. Callanen, Joseph R. Swan and Augustus H. Palmer, all of same place. Application filed March 26, 1886. Renewed Nov. 23, 1886, and July 27, 1887. In a telephone transmitter the combination, with the diaphragm and the mass of finely divided semi-conducting material mounted thereon, forming one terminal of an electric circuit, of



NO. 417,122.—SYSTEM OF SUPPLYING CURRENTS TO ELECTRIC RAILWAY SYSTEMS.

one or more gravitating electrodes forming the other terminal, pivoted at their upper ends, and having their lower ends embedded in the semi-conducting material, being held in contact therewith by gravity alone.

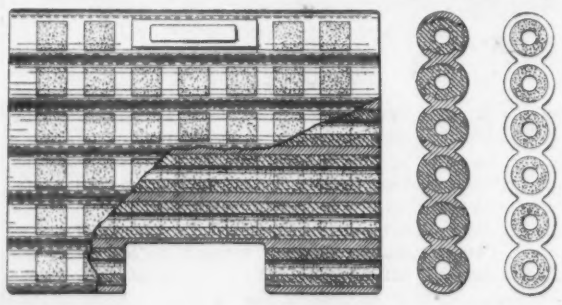
417,013. Electrical Pipe or Metal Welding Machine; Herbert E. Fowler, of New Haven, Conn., Assignor of one-half to D. T. Hedges, of Sioux City, Ia. Application filed July 5, 1889. In a machine for welding metal by electricity, the combination, with means for holding the parts to be welded against rotation, of electrical apparatus for directing current of electricity to the point of weld, means for moving the parts whereby to upset the ends, welding appliances—such as hammers or rolls—adapted to be rotated about the parts to be welded, and means for actuating the welding appliances whereby to form the weld.

417,018. House Telephone Exchange; William M. Goodridge, of Highland Park, Assignor to the Western Electric Company, of Chicago, Ill. Application filed Sept. 5, 1887. The invention consists in switching apparatus and circuits for looping into the general wire of the city telephone any one of the stations in the factory.

417,052. Electric Berth Register for Sleeping-Cars; Frederick Edward Liebnitz, of Birmingham, Ala. Application filed March 29, 1889. The main features of this improved berth register consist of an electro-magnet, an armature, for actuating the register, a battery and a circuit closer actuated by the opening of the upper berth.

417,055. Secondary Battery; Charles Henry Logan, of Toronto, Can. Application filed May 1, 1889. In a secondary battery, battery plates having receptacles for the active material, the receptacles being placed in substantially vertical positions, and slotted or perforated to permit the admission and circulation of the electrolyte through and around the active material or material to be made active, whereby the material to be contained in the receptacles is prevented from being washed or jarred out of the receptacles, and at the same time the active material and the material of which the plate is formed are both permitted to expand and contract independently of each other and without disruption of their contact.

417,075. Electric Gas Lighter; Nelson Newman, of Springfield, Ill., Assignor of two-thirds to George A. Sanders and Samuel J. Willett, both of same place. Application filed May 29, 1889. The time mechanism having the revolving disc provided with the tappets arranged at different distances from its centre, in combination with the gas valve having the tappet arms ex-



NO. 417,158.—SECONDARY BATTERY PLATE.

tending in opposite directions and arranged in the paths of the respective tappets, whereby the valve will be automatically opened and closed, and the electric spark producing apparatus operated by the time mechanism.

417,088. Method of Preparing Electrodes for Secondary Batteries; James Kent Pumpelly, of Chicago, Ill., Assignor of one-half to Frank D. Thomason, of same place. Application filed Oct. 3, 1889. The method of applying active material to the plates or grids comprising the electrodes of electrical secondary batteries, consisting, first, of applying the active material to the plates in a powdered form, and then moistening the active material before the plates are immersed in the electrolytic solution.

417,089. Compound Dynamo Electric Machine; Frank B. Rae, of Detroit, Mich., Assignor to the Detroit Electrical Works, of same place. Application filed May 10, 1889. In a dynamo electric generator, the combination, with a series coil and shunt coil, of vertical cores and two horizontal pole pieces, each of the latter having a circular groove formed therein, bounding the base and top of the core, and of the desired shape and dimensions to accommodate and hold the series coil in a position independent of the shunt winding.

417,095. Electric Conductor; John J. Saville and James H. Winspear, of Omaha, Neb. Application filed March 11, 1889. The combination of a transmitter, a power wire, a lateral wire covered and embedded in insulating water-proof material, the frame carried by the car truck, and having pendent arms connected by cross bars, a carrier bar formed of sections, having lateral and vertical movement bars depending from the carrier bar and having clamps, and the conductor wire.

417,117. Electric Indicator for Grain Bins; Adrial C. Thomson and Horace E. Newton, of Greeley Center, Neb. Application filed Oct. 17, 1889. Consists in a hollow receptable or casing which is adapted to be attached to the bin, the casing containing an electric call button, which is operated by a rod or projection attached to a disc carried by a flexible diaphragm, the diaphragm being secured in place over the end of the casing.

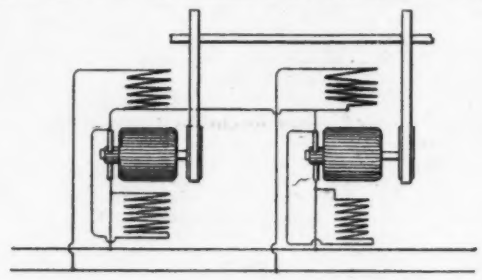
417,120. Drop-Switch for Electric Conductors; Charles J. Van Depoele, of Chicago, Ill. Application filed April 22, 1887. A switch for suspended conductors, consisting of a conductor located above the main conductor and provided with hinged end pieces, one normally resting upon the main conductor to elevate a carriage coming from one direction, and the other normally raised to permit the free passage of a carriage from the other direction without leaving the main conductor, but adapted to be depressed into contact with the main conductor by the first-mentioned carriage when reaching the opposite end of the switch.

417,121. System of Switching for Conduit Electric Railways; Charles J. Van Depoele, of Lynn, Mass. Application filed Feb. 2, 1889. In electric railways, the combination of main and branch slotted conduits, the slots in the conduits being closed by flexible packing, a contact plow moving between and separating the packing in its passage, a car arranged to move along the line of the main or branch conduits, and connections between the car and contact plow for holding the plow toward the unbroken wall of the slot, closing the packing of the conduit when passing a branch or turnout.

417,122. System of Supplying Currents to Electric Railway Systems; Charles J. Van Depoele, of Lynn, Mass. Application filed April 13, 1889. The system comprises a bare working conductor or conductors running parallel to the line of the railway and adapted to supply current to traveling motors, between which and the working conductors a moving connection is established in any desirable manner. The working conductors may be suspended above the track or placed in sub-surface conduits, as desired. The supply current is led from the generator through a trunk line, following the most direct route and terminating at a point from which a number of short feeders are connected to the respective sections of the working conductor or conductors. See illustration.

417,132. Electro-Valve-Operating Device for Elevators; Cyrus W. Baldwin, of Yonkers, New York, Assignor to the Hydraulic Elevator Company, of Chicago, Ill. Application filed September 12, 1888. The combination, with an elevator engine, cage and controlling-valve, of a brake and brake operating devices carried by the cage, an electromotor, and connections between the latter and the valve, and flexible conductors extending from the motor to the brake operating devices, and contacts arranged to complete the circuit through the connections in one direction or the other, accordingly as the brake operating device is shifted.

417,158. Secondary Battery Plate; Victor H. Ernst, of Jersey City, N. J. Application filed Sept. 28, 1889. A battery



NO. 416,746.—COUPLING ELECTRIC MOTORS.

plate having the active material embedded therein, with a passage in the interior of the active material extending parallel with the surface of the plate, whereby the acid of the battery can gain access to the interior of the active material. See illustration.

417,188. Electric Danger Alarm for Railway Block Signals; James H. Hunter, of New York, N. Y. Application filed Aug. 31, 1889. A locomotive provided with a distributer, a normally closed electric circuit, including a generator and a coil, armature, and core of one magnet, of the distributer, an electric signal or bell, a normally open circuit, including the generator, the signal magnet and the core and armature of the other magnet of the distributer, and a constantly closed exciting circuit, including the generator, the coil of the magnet and an external resistance.

417,198. Electric Gas Lighter; Nelson Newman, of Springfield, Ill. Application filed Sept. 11, 1889. The combination, a gas burner and a valve having the tappet arms of a time mechanism having a revolving disc, the contacting arms forming electrodes and arranged to meet and separate above the burner, one of the contacting arms having a lever and the other having a pendulum, with a rod connecting the contacting arms and adjustable tappets arranged on the disc.

PATENTS EXPIRED DEC. 10, 1889.

133,797. Improvement in Keys for Use with Electrical Apparatus; Joseph Olmstead, of Providence, R. I. A key or switch operating a rheostat for the purpose of varying current delivered to a translating device.

133,841. Improvement in Type-Writing Machines; Thomas A. Edison, of Newark, N. J., Assignor to himself and George Harrington, of Washington, D. C. A type wheel moved along in the line of its axis by a progressive movement between one impression and the next so as to print from such type-wheel in a line.

PATENTS EXPIRING DEC. 17, 1889.

133,968. Improvement in Electro-Magnets for Telegraphy; William E. Davis, of Jersey City, N. J. This invention relates to a combination of one electro-magnetic coil and its magnets with two or more armature levers which are simultaneously affected by the currents through the coil, thus utilizing the same electro-magnet for operating a suitable number of instruments at once.

134,053. Electro-Magnetic Annunciators for Hotels; Otto Hagendorf, of New York, N. Y. The invention consists in the arrangement of an announcing disc on a lever, which, when left to follow its own gravity, drops in such a position that the announcing disc is brought behind a figure painted in dark color on a transparent surface. With the announcing disc lever is combined a recovering slide and the armature of an electro magnet, and if the recovering slide is moved in the proper direction the announcing disc lever catches over a pin projecting from the armature, whereby the announcing disc is locked back until the circuit through the electro-magnet is closed.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.

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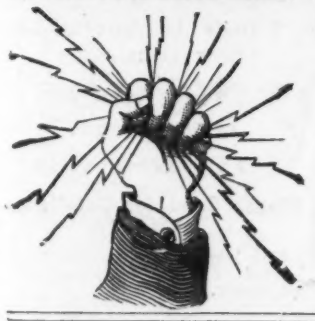

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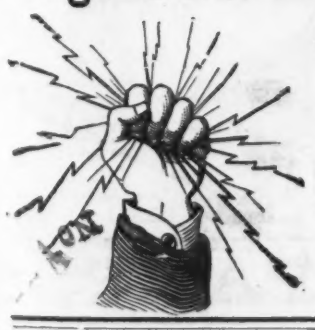

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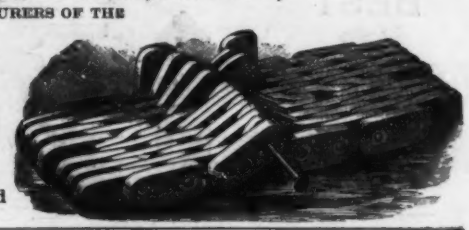

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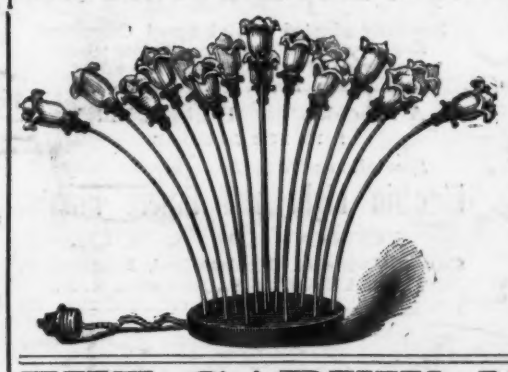

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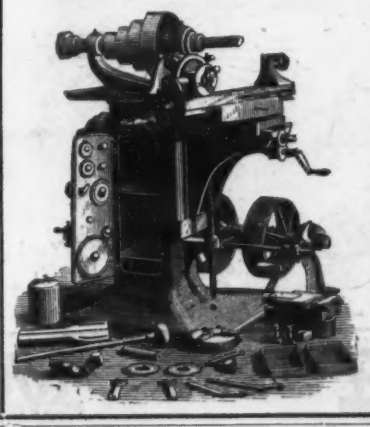

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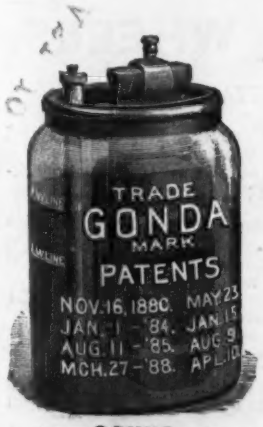

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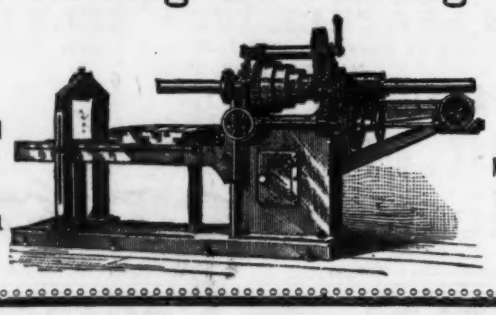

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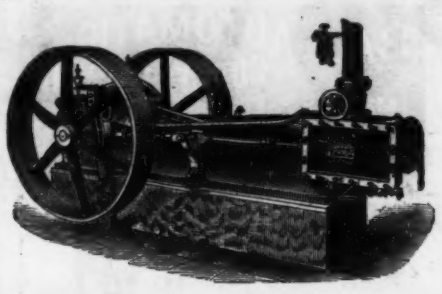

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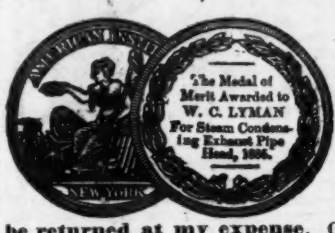

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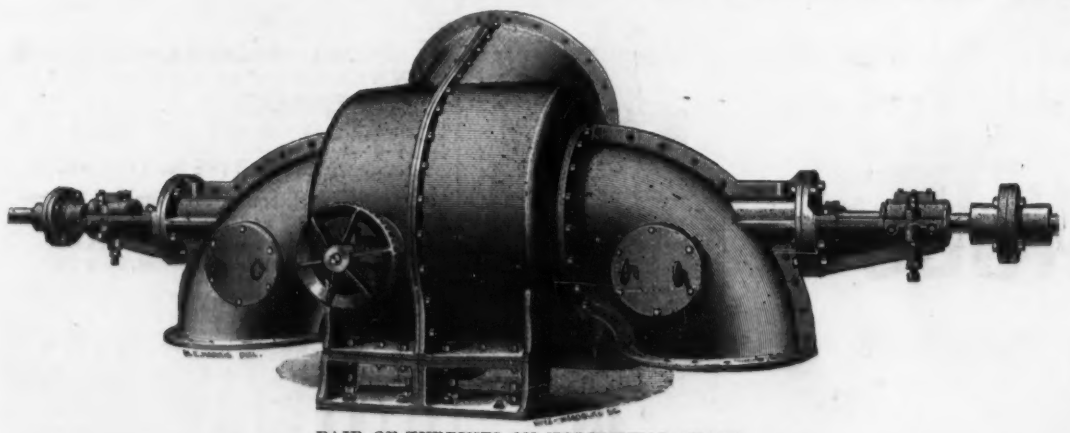

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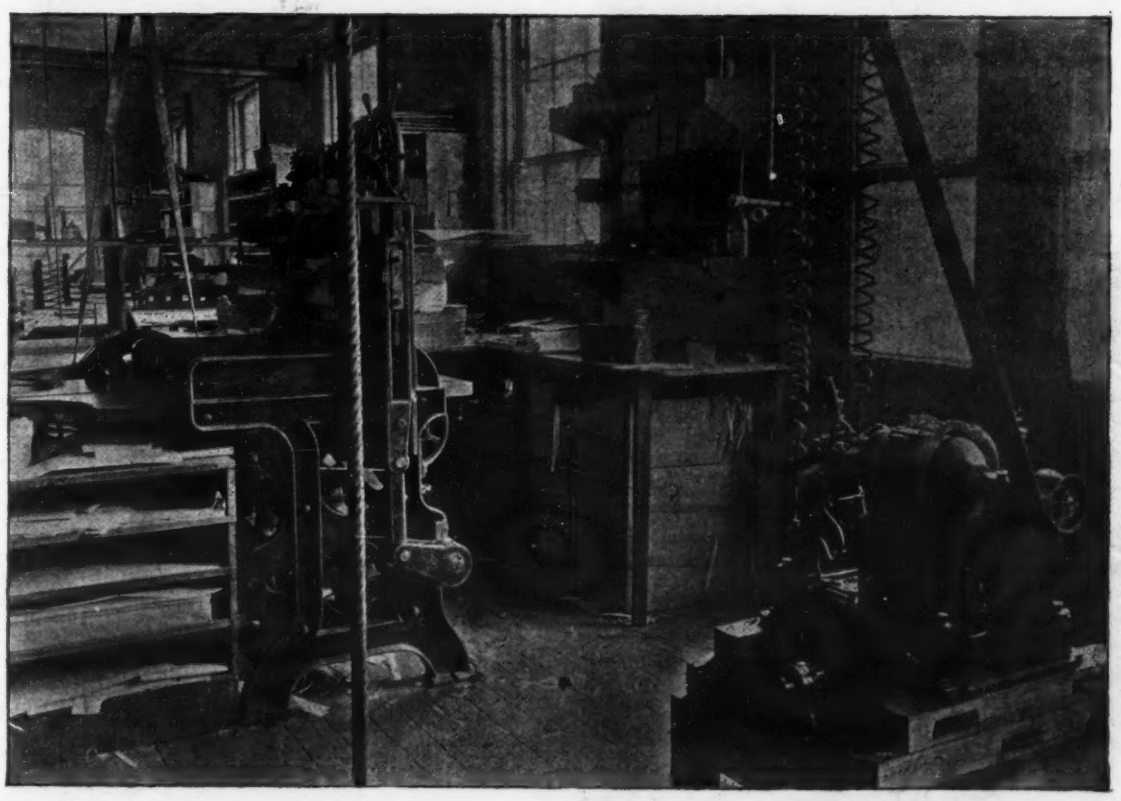

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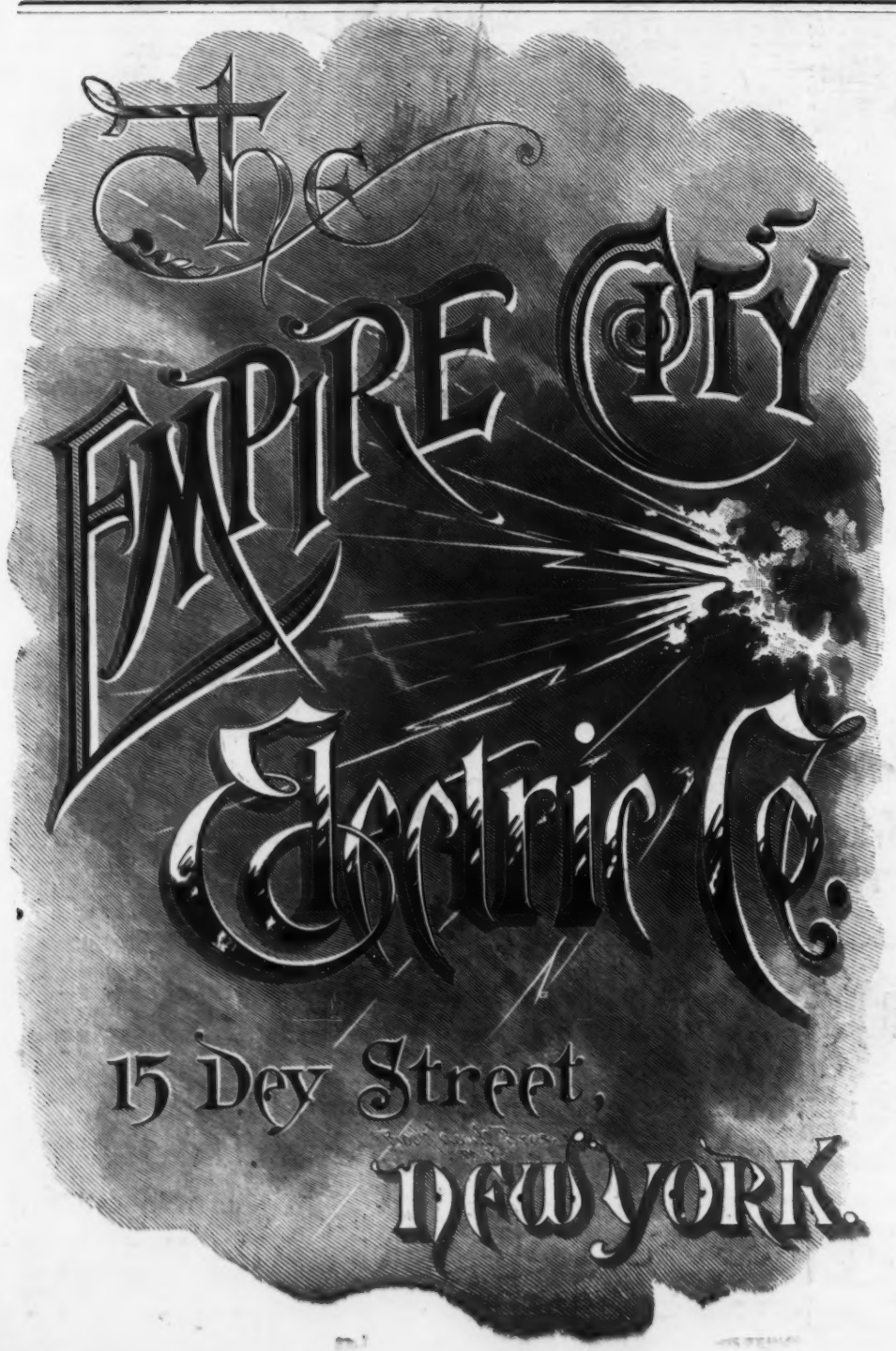

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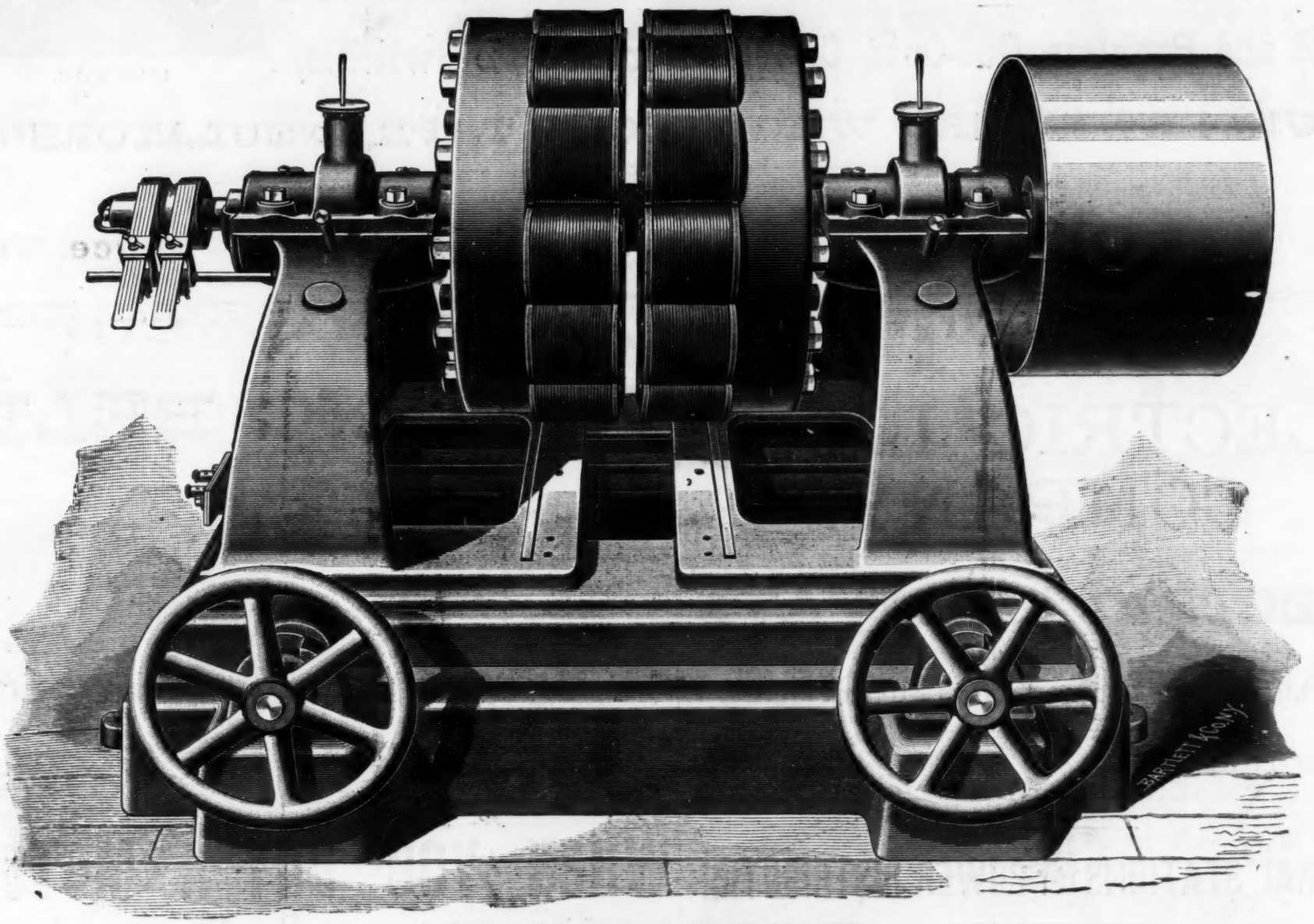

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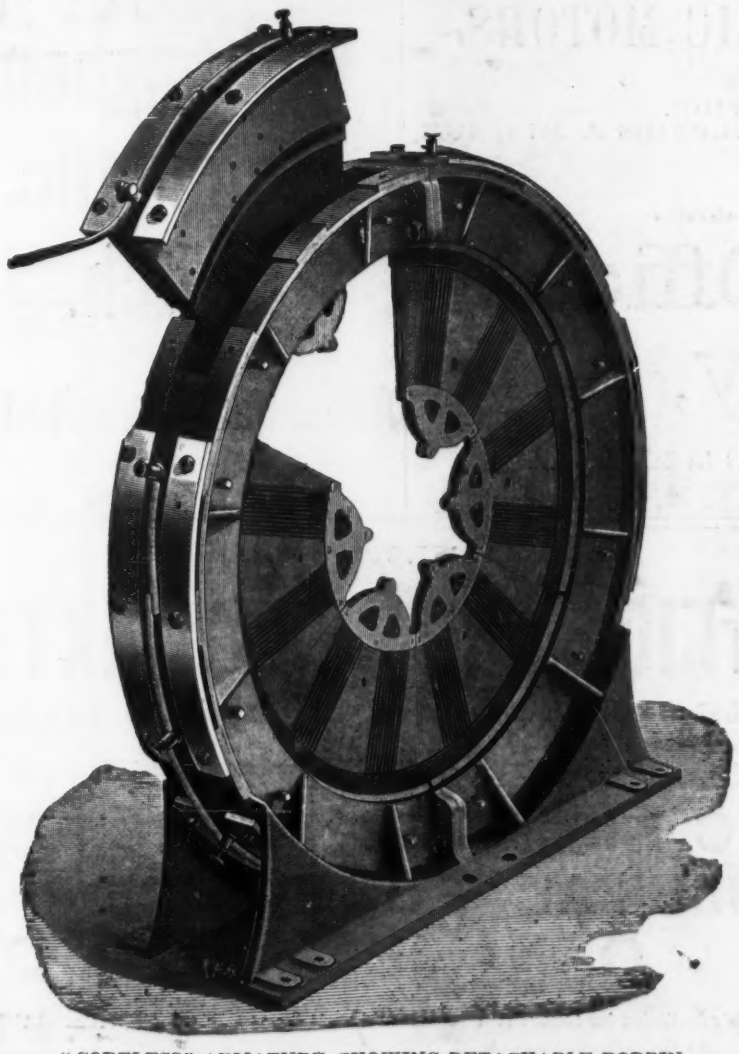

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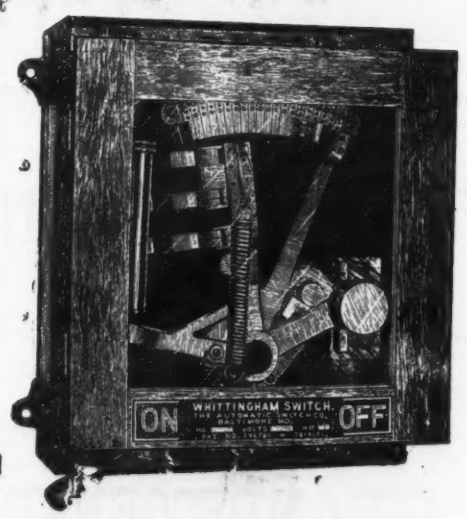

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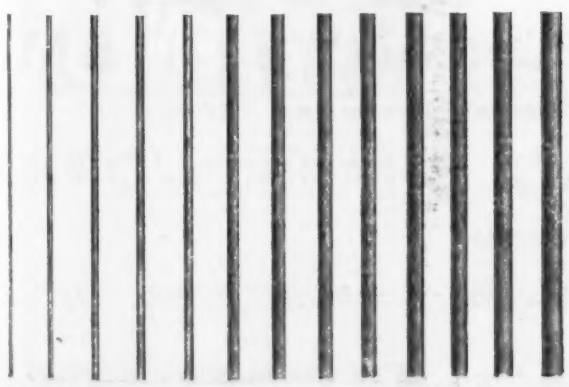

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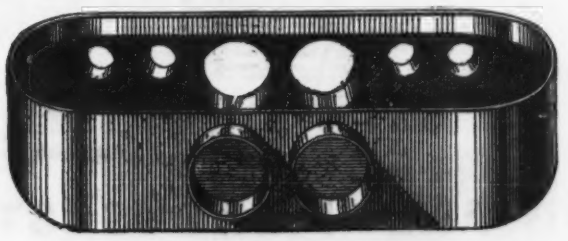

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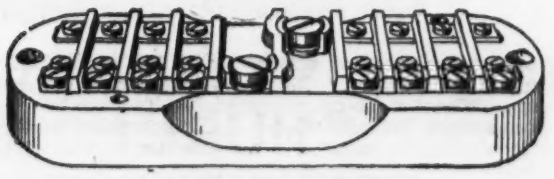

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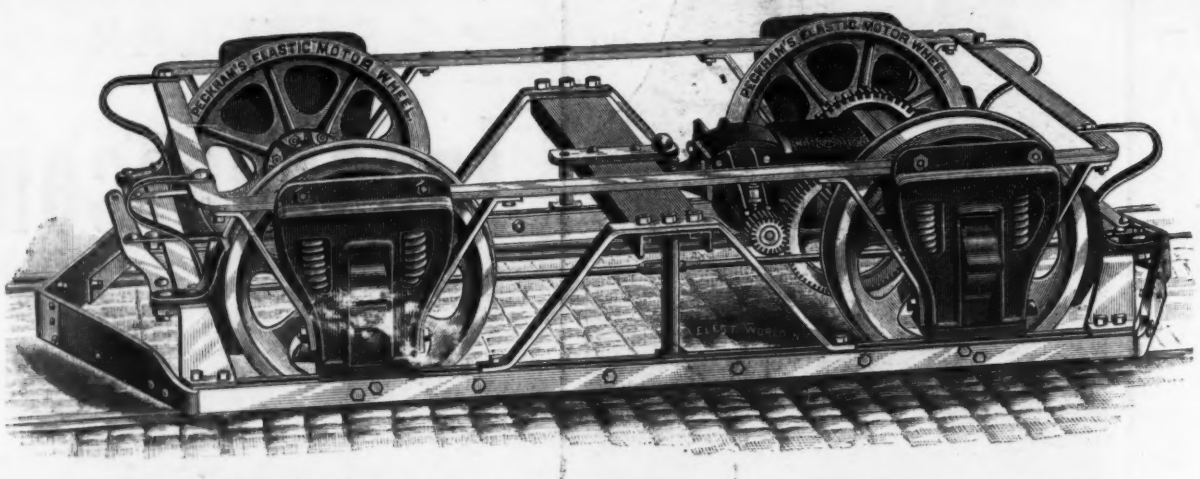

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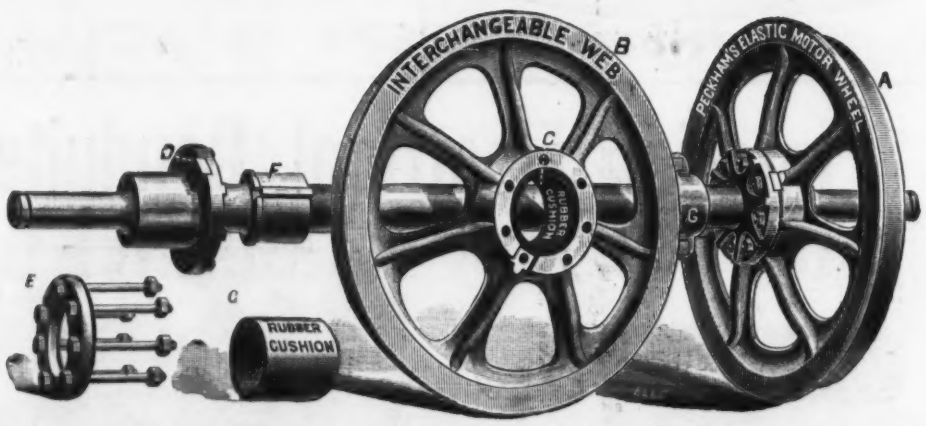

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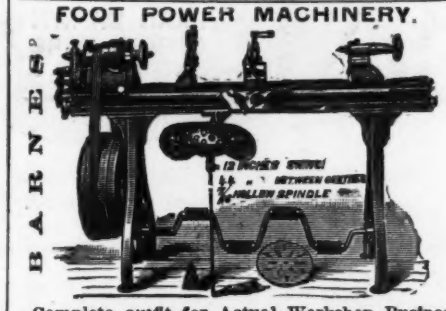

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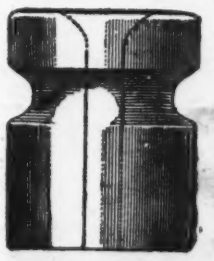

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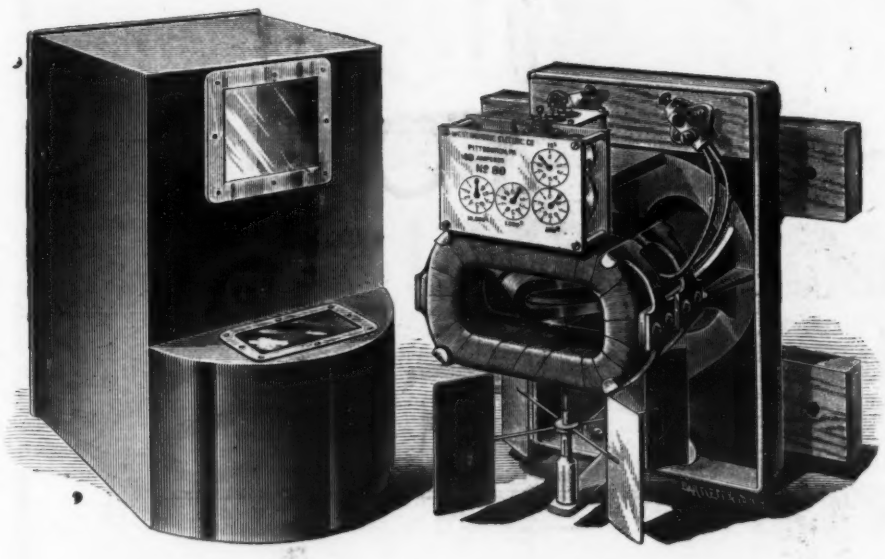

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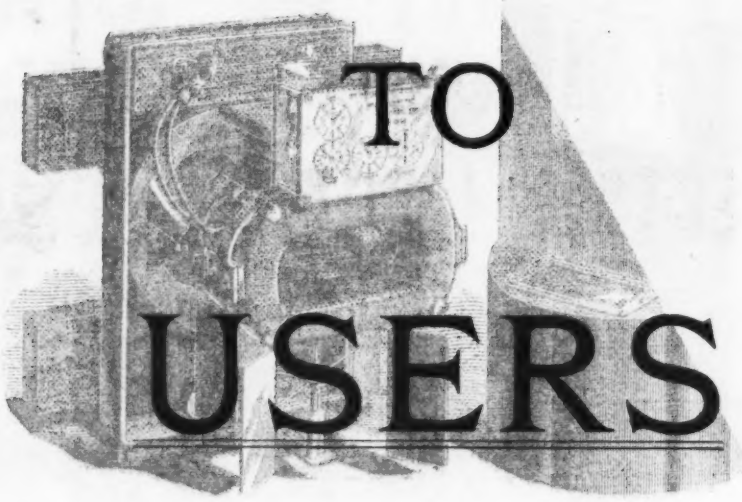

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Brooklyn, N. Y., Dec. 4, 1889.

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(Signed) P. L. WATSON, Superintendent.

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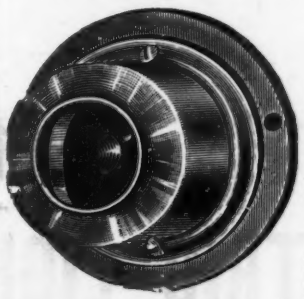

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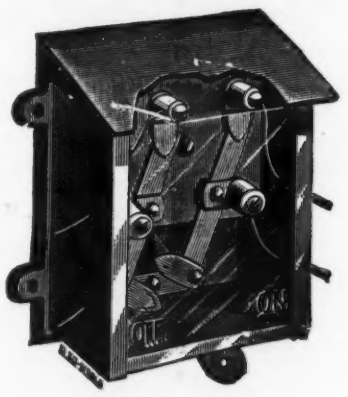

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Says: "I have been carrying a Paillard Non-Magnetic Watch in my pocket and going around dynamos and other electrical appliances, where I have never been able to carry a watch without ruining it, and it has proved an excellent time-keeper. I consider Paillard's Balance and Hair Spring a most wonderful and valuable invention, not only for workers around dynamos, but wherever accuracy of time is required." PAILLARD NON-MAGNETIC WATCHES cost no more than other makes in equal grades, and are, without question, superior to any other make.

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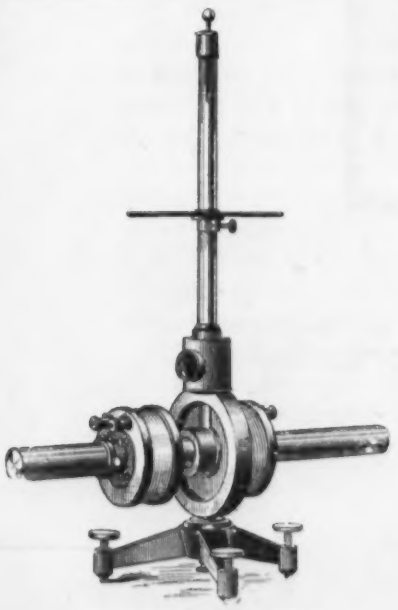

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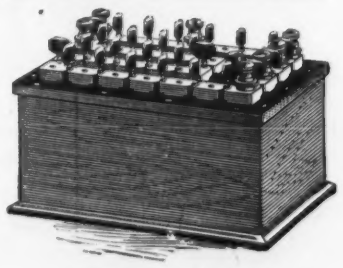
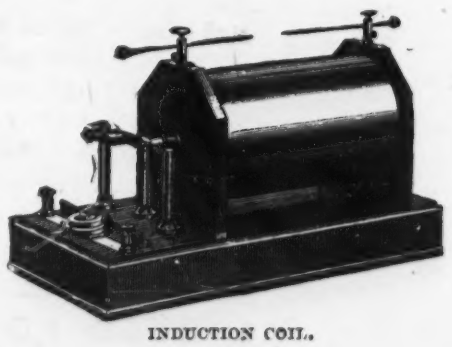


WHEATSTONE BRIDGE.



INDUCTION COIL.

THE BEGINNING OF THE END.

Edison Company Sustained. Westinghouse Company Defeated.

SAWYER-MAN PATENT DECIDED BY THE COURT TO BE A FRAUD AND ABSOLUTELY VALUELESS.

Extracts from the Decision of Justice Bradley, Oct. 5, 1889.

Circuit Court of the United States for the Western District of Pennsylvania.

THE CONSOLIDATED ELECTRIC LIGHT COMPANY
(WESTINGHOUSE COMPANY)
versus
McKEESPORT LIGHT COMPANY
(EDISON COMPANY).

No. 5, May Term 1888.
On Bill and Final Hearing.

EXTRACTS FROM OPINION OF THE COURT.

"The great question in this suit is whether the patent sued on is valid, so far as involves a general claim for the use in electric lamps of incandescing carbon conductors made of fibrous or textile substances. If it is, the complainant must prevail. If it is not, the bill must be dismissed."

"Is the patent valid for such a broad claim? The defendants contend that it is not; first, because no such invention was set forth in the original application, but was introduced more than four years after it was filed, and after the same material had been used by Edison, and claimed by him in application for a patent; secondly, because Edison, and not Sawyer-Man, was really the original and first inventor of an incandescent conductor made of fibrous or textile material for an electric lamp."

"It is very clear to us that in the original application for the patent sued on the applicants had no such object in view as that of claiming all carbon made from fibrous and textile substances as a conductor for an incandescing electric lamp. Nothing on which to base any such claim is disclosed in the original application. We have carefully compared it with the amended application, on which the patent was issued, and are fully satisfied that after Edison's inventions on this subject had been published to the world there was an entire change of base on the part of Sawyer & Man, and that the application was ammended to give it an entirely different direction and purpose from what it had in its original form."

"By an adroit amendment made in 1885, they say: 'Our improvement relates more especially to the incandescing conductor, **its substance,** its form and its combination with the other elements composing the lamp.' The purpose of this amendment is obvious, and needs no comment."

"The fact is that Sawyer & Man were unconscious that the arc was not new, and supposed that they could get a patent for it; but, as their eyes were opened, they changed about and amended their application, and made the material of the conductor the great object—carbon made from fibrous or textile material. Compare the original with the amended application, as first stated in this opinion, and this purpose most obviously appears."

"The fact that the whole object of the application was changed is evinced by the correspondence of the parties."

"This testimony of Mr. Broadnax, which is undoubtedly to be relied on, in connection with the letter just quoted, shows that the idea of claiming carbons made from fibrous and textile materials was an afterthought, and was no part of the purpose of the original application. The amendments relating to this new and broad claim were made afterward, in February and March, 1885."

"We are of the opinion that the changes made in the application in this regard were not justifiable, and that the claim in question cannot be sustained."

"We are not at all satisfied that **Sawyer & Man** ever made and reduced to practical operation any such invention as is set forth and claimed in the patent in suit. Their principal experiments were made in 1878, and perhaps the beginning of 1879. The evidence as to what they accomplished in the construction of electric lamps is so contradictory and suspicious that we can with difficulty give credence to the conclusions sought to be drawn from it. **We are not satisfied that they ever produced an electric lamp with a burner of carbon made from fibrous material, or any other material, which was a success."**

"The application for the patent in suit was not made until January, 1880, nearly or quite a year after all their experiments had ceased, and after the inventions of Edison had been published to the world."

"The explanations made by the complainants for the delay in applying for the patent in suit fail to satisfy our minds that Sawyer & Man, or their assignees for them, have not sought to obtain a patent to which they were not legitimately entitled."

"But, suppose it to be true, as the supposed inventors and some of the other witnesses testify, that they did in 1878 construct some lamps with burners of carbon made of fibrous material, and of an arched shape, which continued to give light for days or weeks or months; still, were they a successful invention? Would any one purchase or touch them now? Did they not lack an essential ingredient which was necessary to their adoption and use? Did they go any farther in principle, if they did in degree, than did other lamps which had been constructed before? It seems to us that they were following a wrong principle—the principle of small resistance in an incandescing conductor, and a strong current of electricity—and that **the great discovery in the art was that of adopting high resistance in the conductor with a small illuminating surface, and a corresponding diminution in the strength of the current. This was accomplished by Edison in his filamental thread-like conductors, rendered practicable by the perfection of the vacuum in the globe of the lamp.** He abandoned the old method of making the globe in separate pieces, cemented together, and adopted a globe of one entire piece of glass, into which he introduced small platinum conductors, fastened by fusion of the glass around them, thus being able to procure and maintain perhaps the most perfect vacuum known in the arts. In such a vacuum the slender filaments of carbon, attenuated to the last degree of fineness, may be maintained in a state of incandescence without deterioration for an indefinite time, and with a small expenditure of electric force. **This was really the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purposes of general use in houses and cities."**

"The principal and great thing described is the attenuated filament and its enclosure in a perfect vacuum."

"We think we are not mistaken in saying that but for this discovery electric lighting would never have become a fact. We have supposed it to be the discovery of Edison because he has a patent for it. This may not be the case. It may be the discovery of some other person; but, whoever discovered it, it is undoubtedly the great discovery in the art of practical lighting by electricity."

"THE BILL MUST BE DISMISSED."

PRICE OF LAMPS MUCH REDUCED. SEND FOR OUR NEW PRICE-LIST OF LAMPS.

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C. SORLEY, Chief Electrician.

MANUFACTURERS AND OWNERS OF

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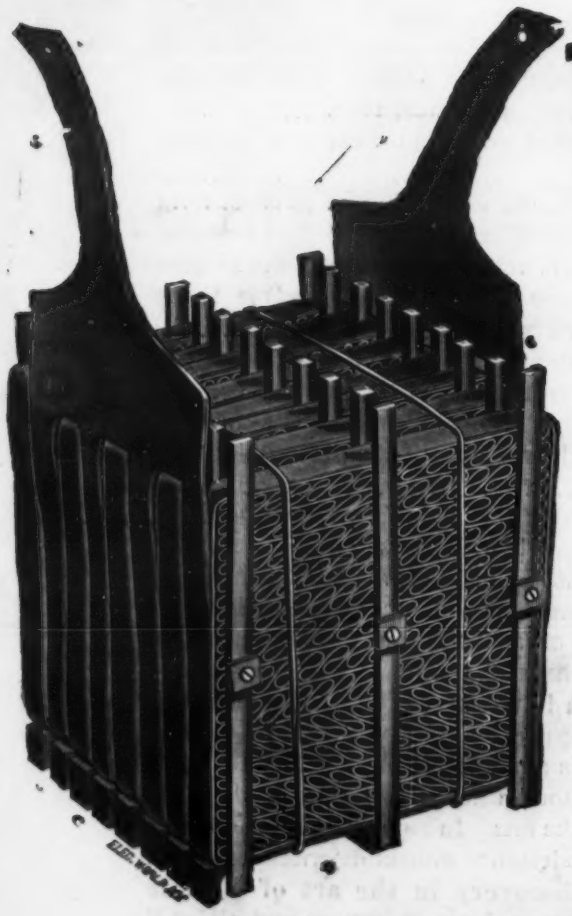
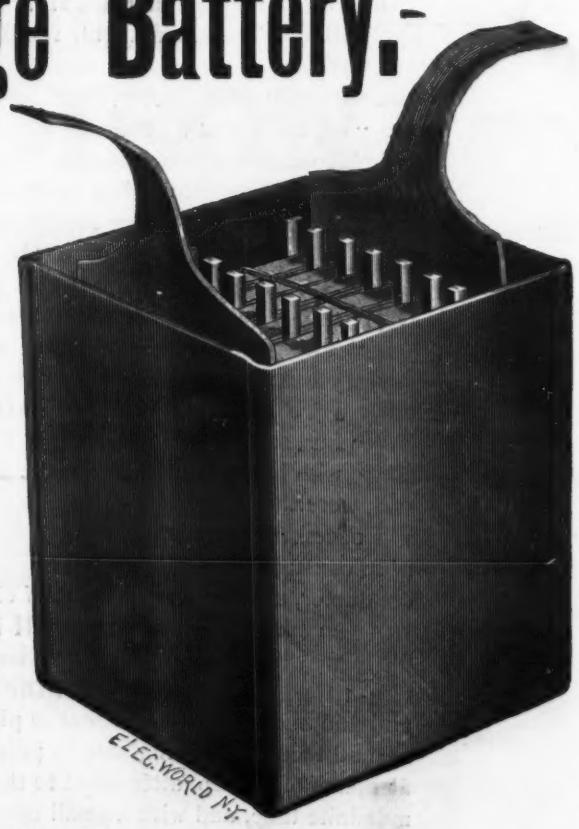


The construction of the Element and the placing of the active material in the plates dry is entirely different from any other battery. We challenge the claims of any competitor, both as to efficiency, energy or durability, and notify the public that we are prepared to guarantee all users of this Battery against any assumed claims based upon any recent decisions, or any other claims.



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SOME ADVANTAGES OF THE SORLEY BATTERY:

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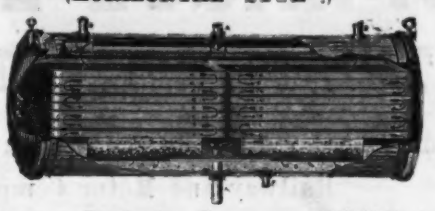

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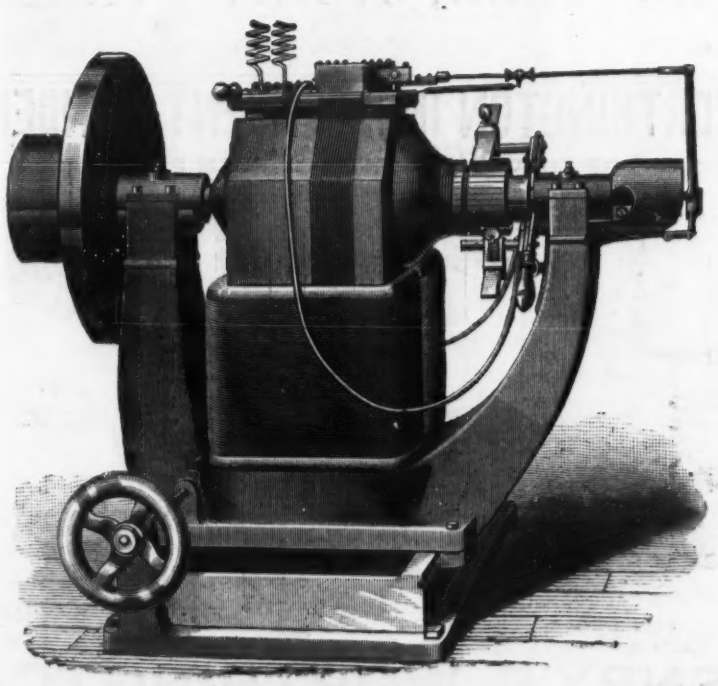

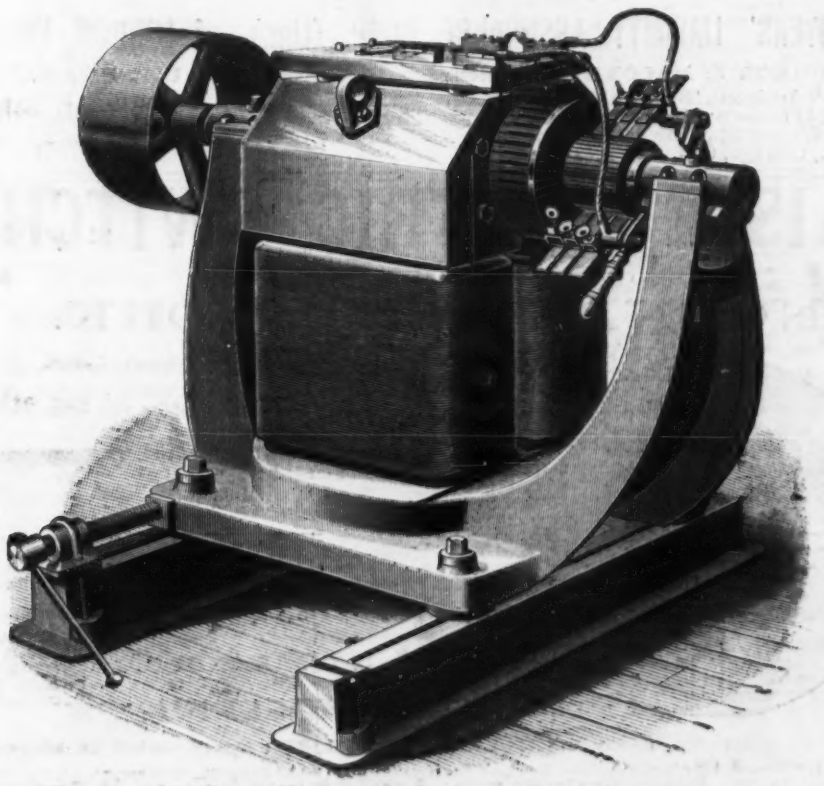

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More Car Miles per Ton of Coal Consumed,
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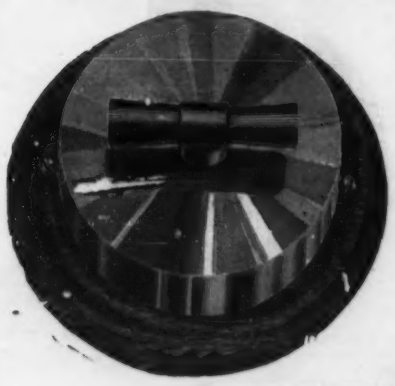

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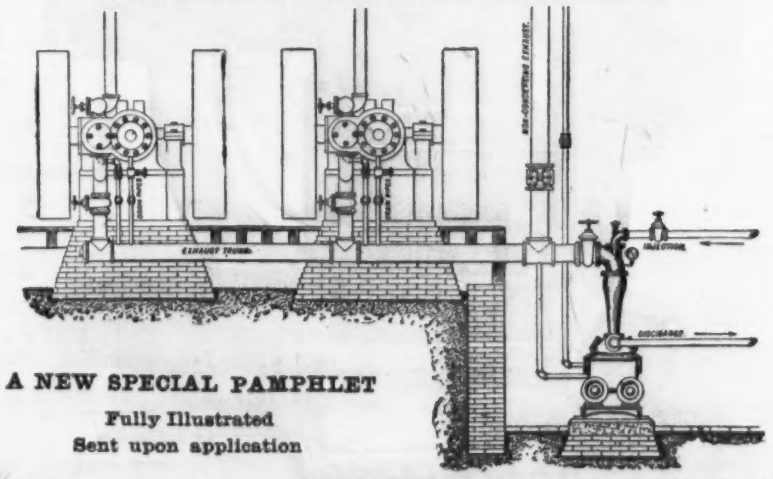

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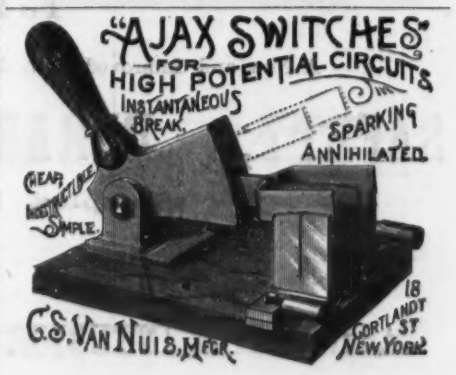

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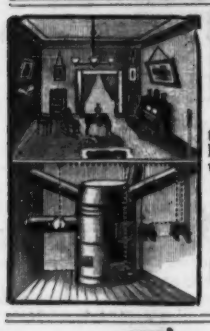

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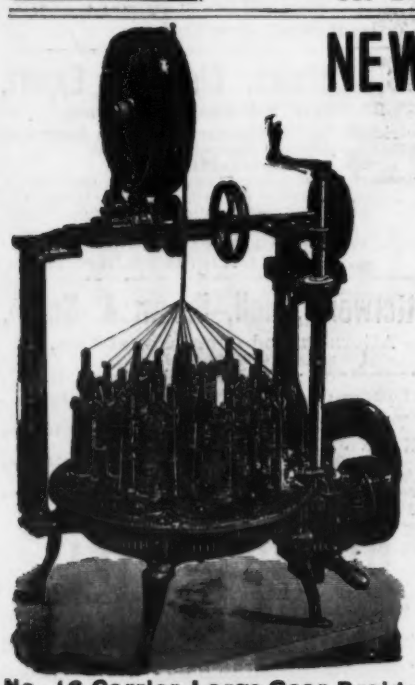

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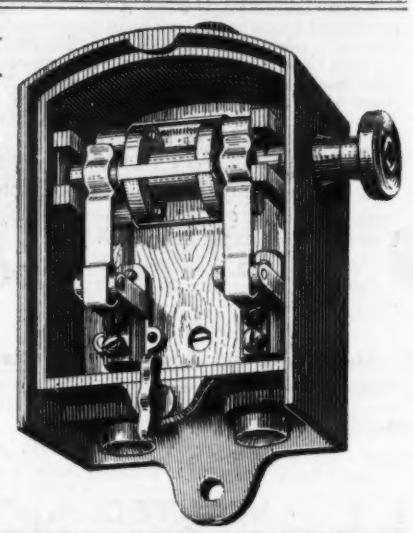

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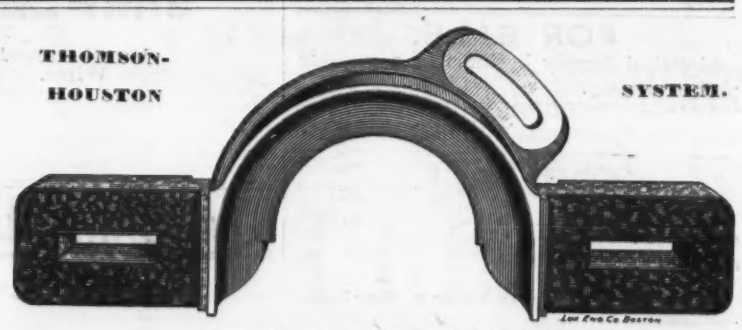

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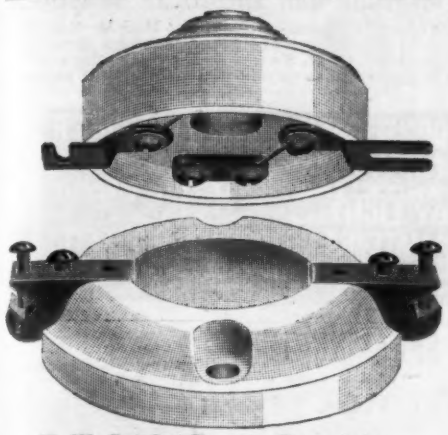

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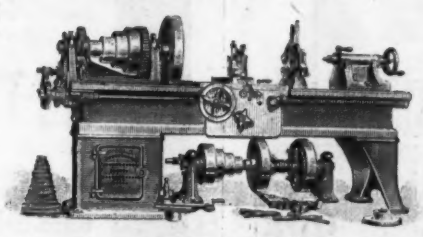

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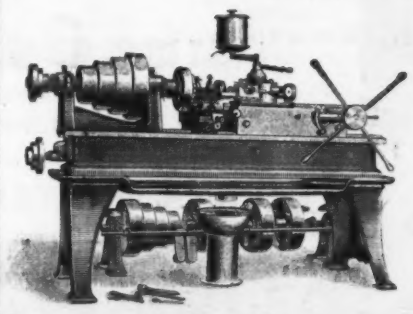

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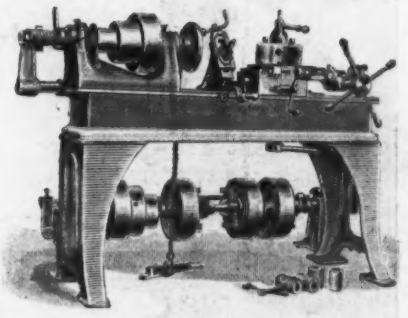

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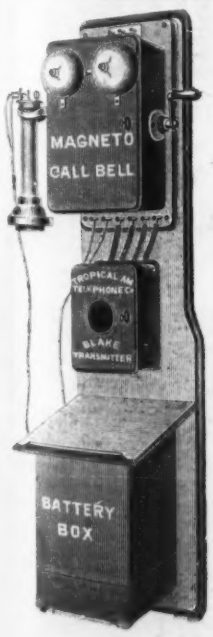

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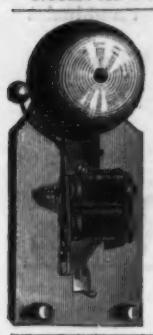

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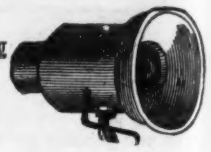

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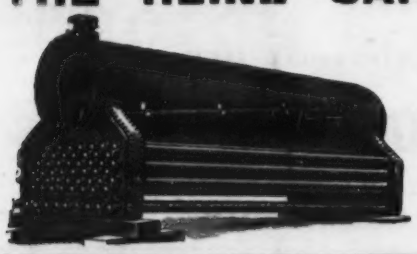

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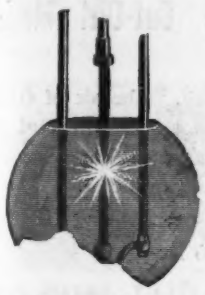

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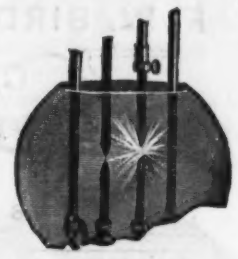

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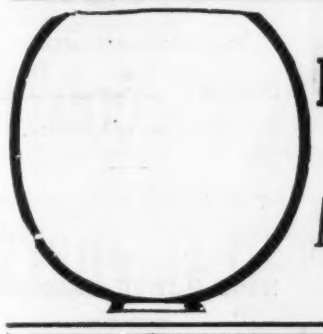

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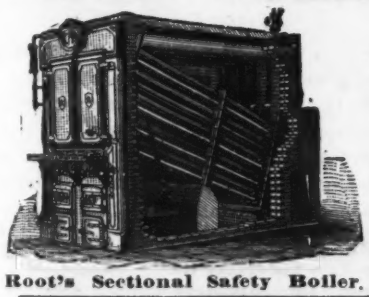

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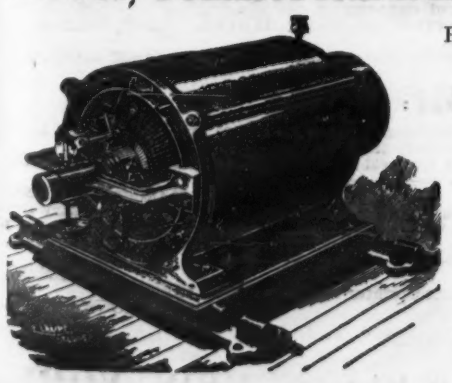

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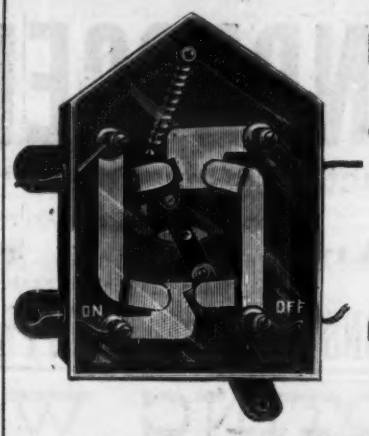

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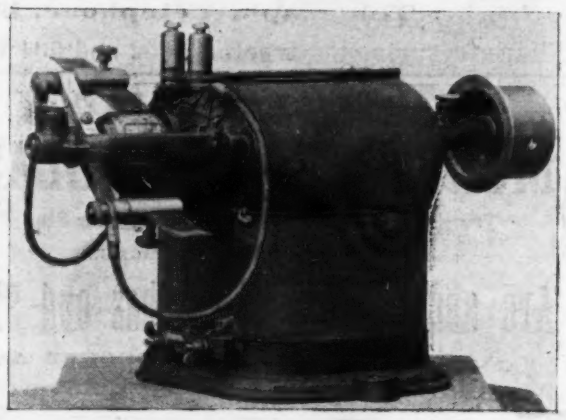

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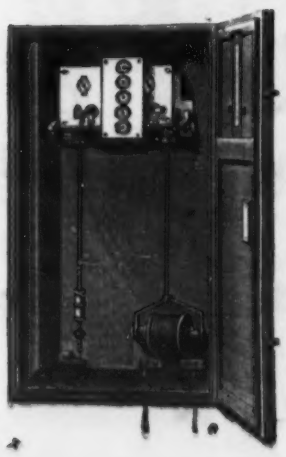

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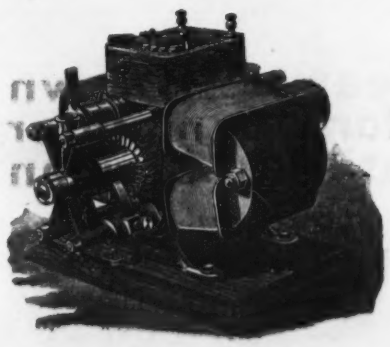

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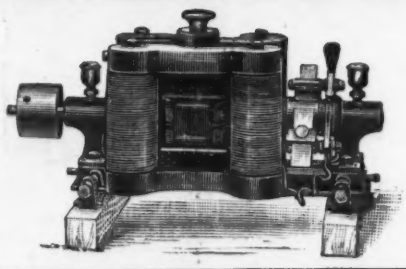

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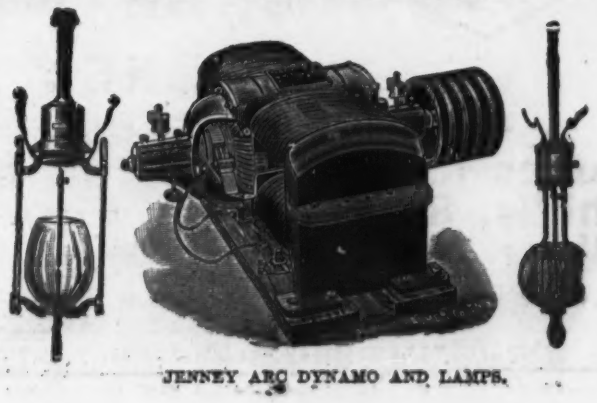

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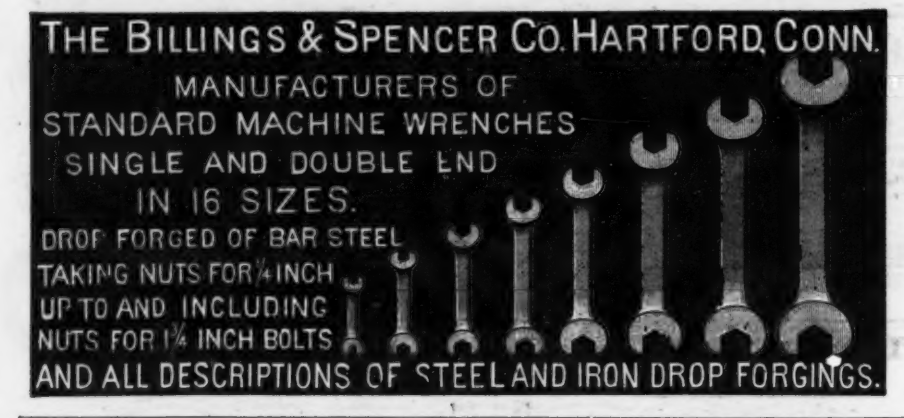

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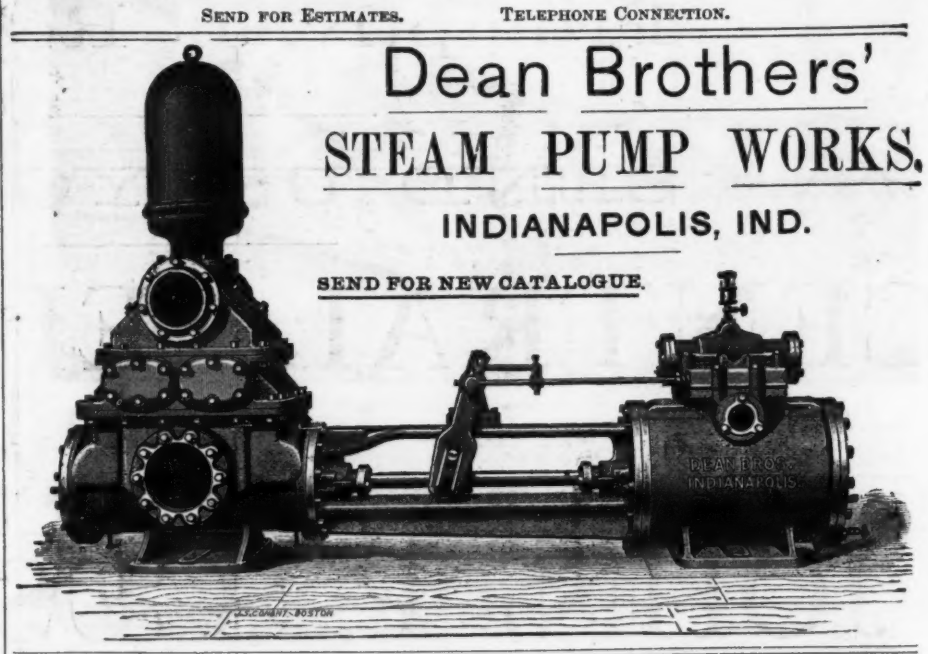

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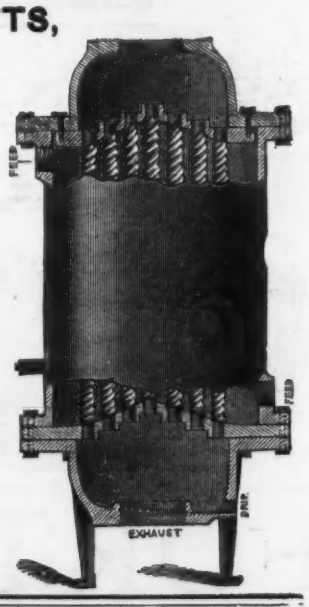

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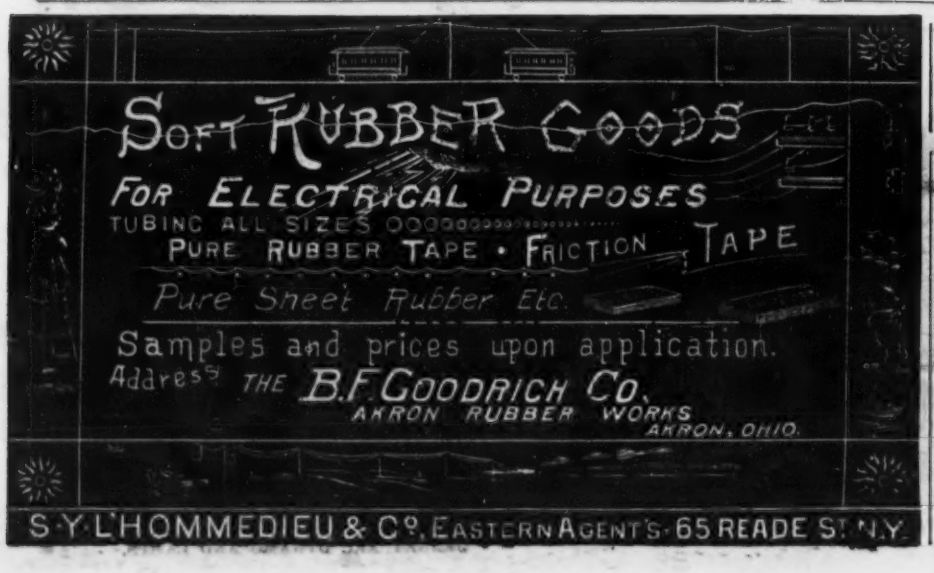
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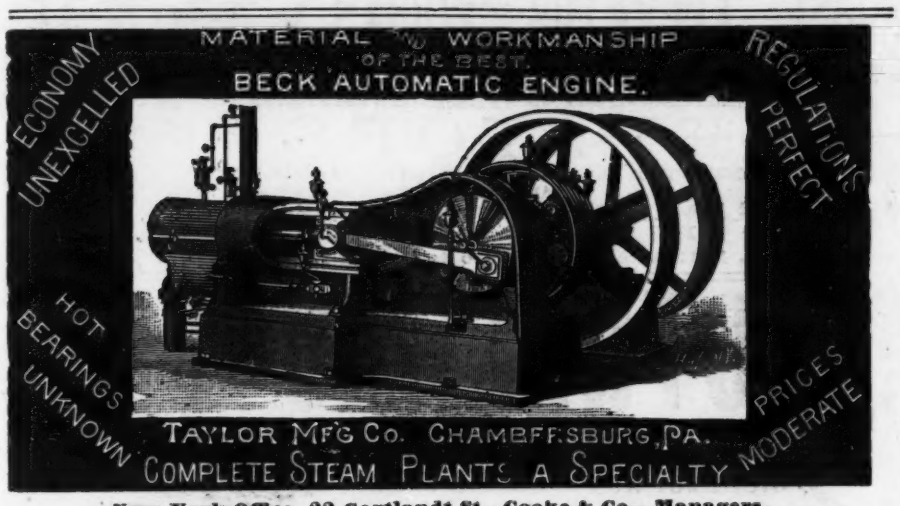

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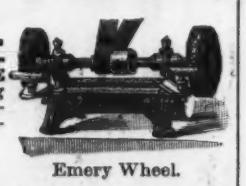

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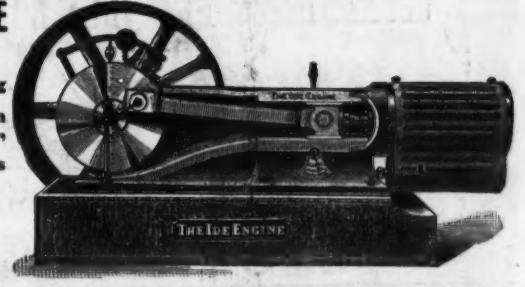

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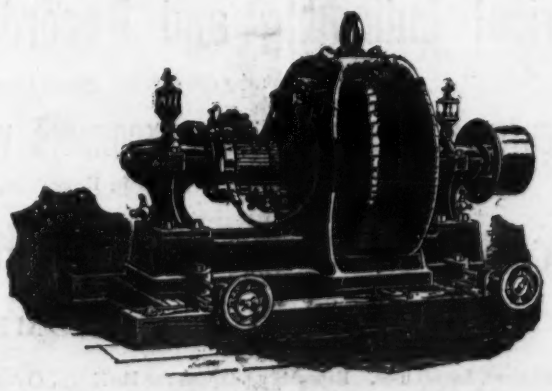

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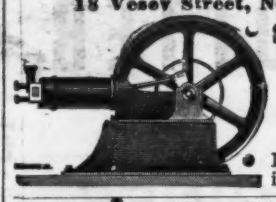

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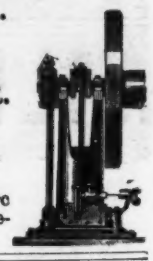

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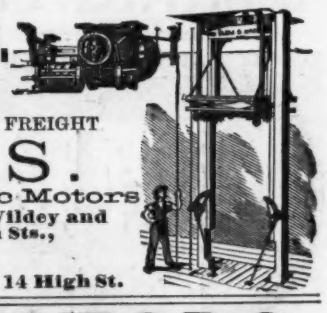

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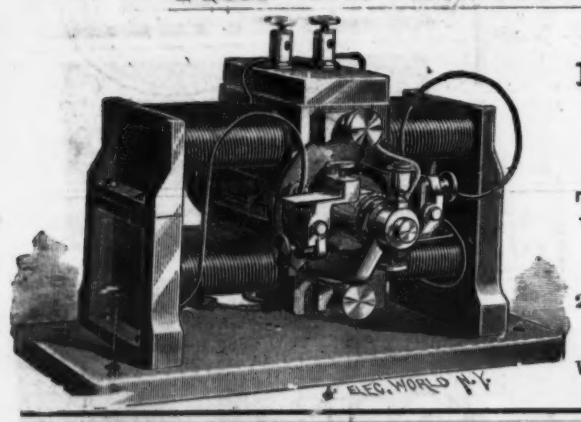

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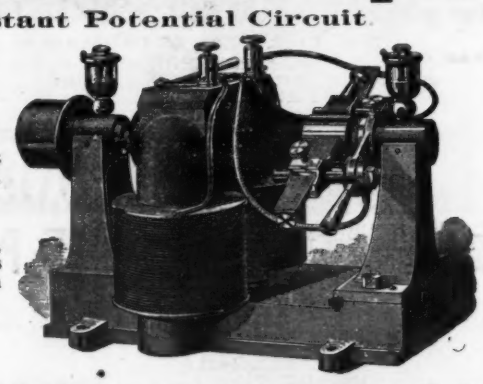

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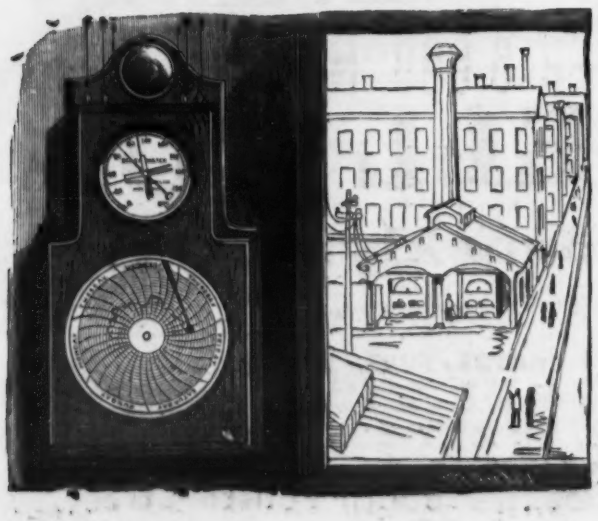

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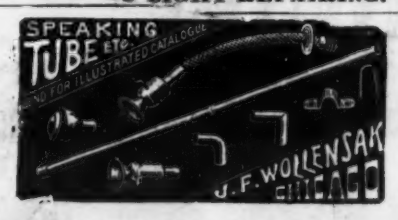

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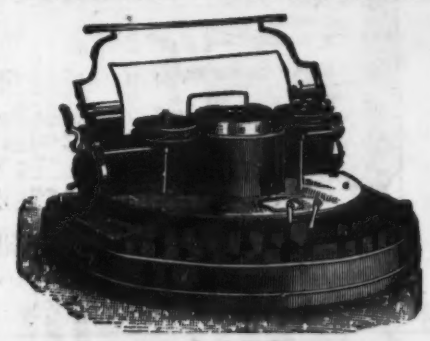

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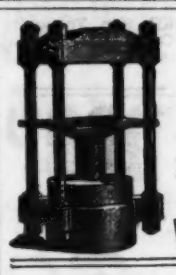

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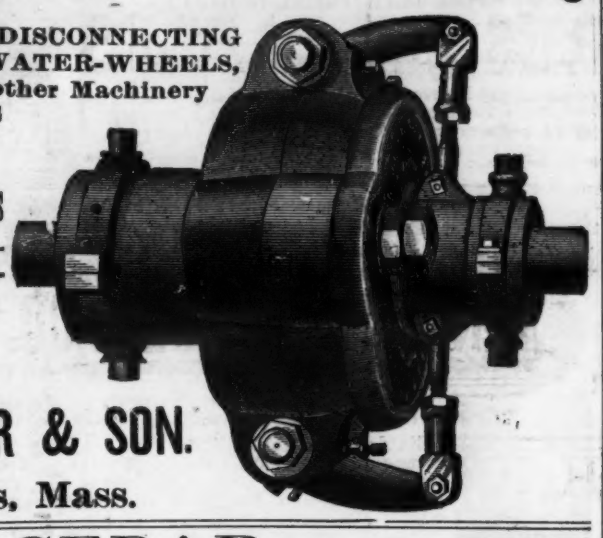

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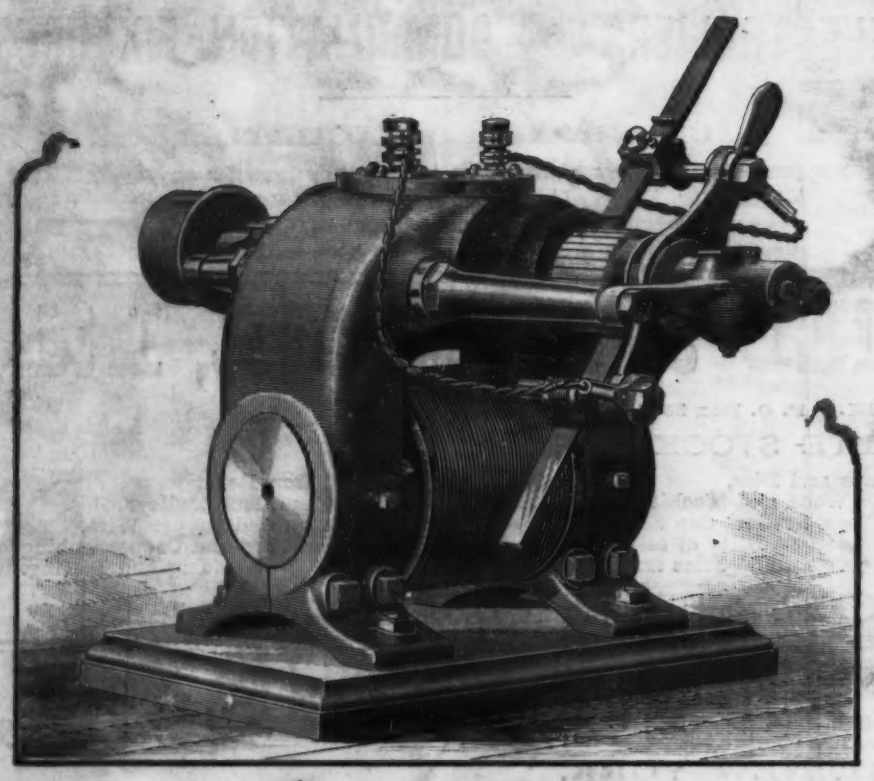

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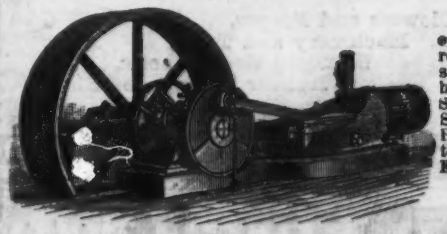

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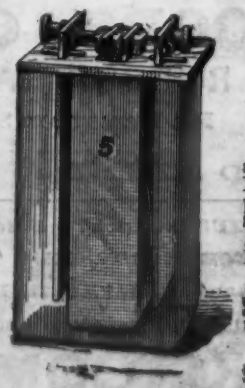

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